

# **SIGNAL**

Communications—Electronics—Photography • On Land Sea and Air



SIGNAL SALUTES 40TH ANNIVERSARY

1918

**VETERANS' DAY**

1958

*November 1958*

# for the HIGHEST in RELIABILITY

UTC is the only company in the world that is truly natural, since we maintain the largest laboratory and engineering staff in our field. However, a single test cannot provide the measure of uniformity and reliability inherent in UTC units. To provide for the maximum in quality and reliability, continuing programs of quality control and quality improvement are constantly maintained in our laboratories.

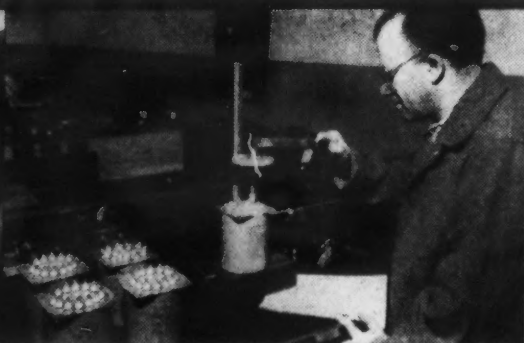
**WHAT MAKES A TRANSFORMER FAIL?**  
Illustrated are a few views of the UTC Reliability Laboratory in action... finding the answers.



Qualitative micro analysis.



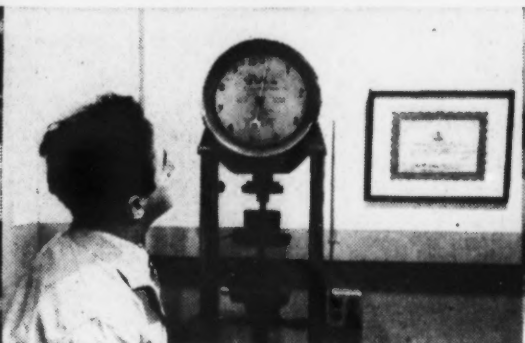
Vibration stress analysis.



Torque testing of standard assemblies.



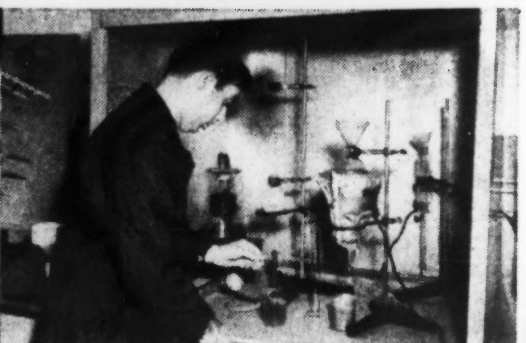
Checking uniformity of thermoplastic compounds.



Quantitative checking of weld strength.



Hermetic terminals on microscope check.



Chemical section analyzing new materials.



Microscope analysis of dissected units.



Calibration to primary standards.



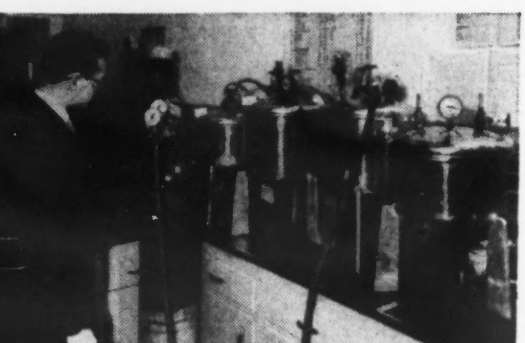
Pilot plant hydrogen annealing.



Seal tests under extremes of cold, heat, and altitude.



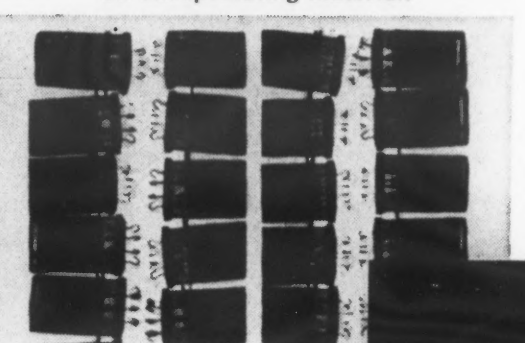
Abrasion and mercury tests on magnet wire.



Pilot plant run on encapsulating material.



Corrosion testing on insulating materials.



Non-destructive quality control by x-ray.

## IS THIS PROVEN RELIABILITY AND UNIFORMITY IN THE COMPONENTS OF YOUR EQUIPMENT?

**A large aircraft company...** "Our vendor analysis for past year (thousands of tests) shows zero rejects."

**A large electric company...** "Consistent quality has placed you as our #1 source...are grateful for the aid you have given our own quality control staff."

**A large military electronics company...** "Switching from former vendor to UTC has saved us 18% of transformer and filter cost by reducing manufacturing costs."

**A large instrumentation company...** "We haven't had one field failure in fifteen years' use of UTC parts\*."

\*Over 100,000 units.

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# NEW DIODE SPEEDS VOICES—



## AT 6,000,000,000 C. P. S.

How the radio art can be improved through solid state science is illustrated by a recent development at Bell Telephone Laboratories. To make voice signals travel by microwaves they must first be "converted"—caused to vibrate at billions of cycles per second. To date, it has been possible to accomplish this conversion only at the cost of appreciable loss of signal energy. Could a more efficient converter be provided?

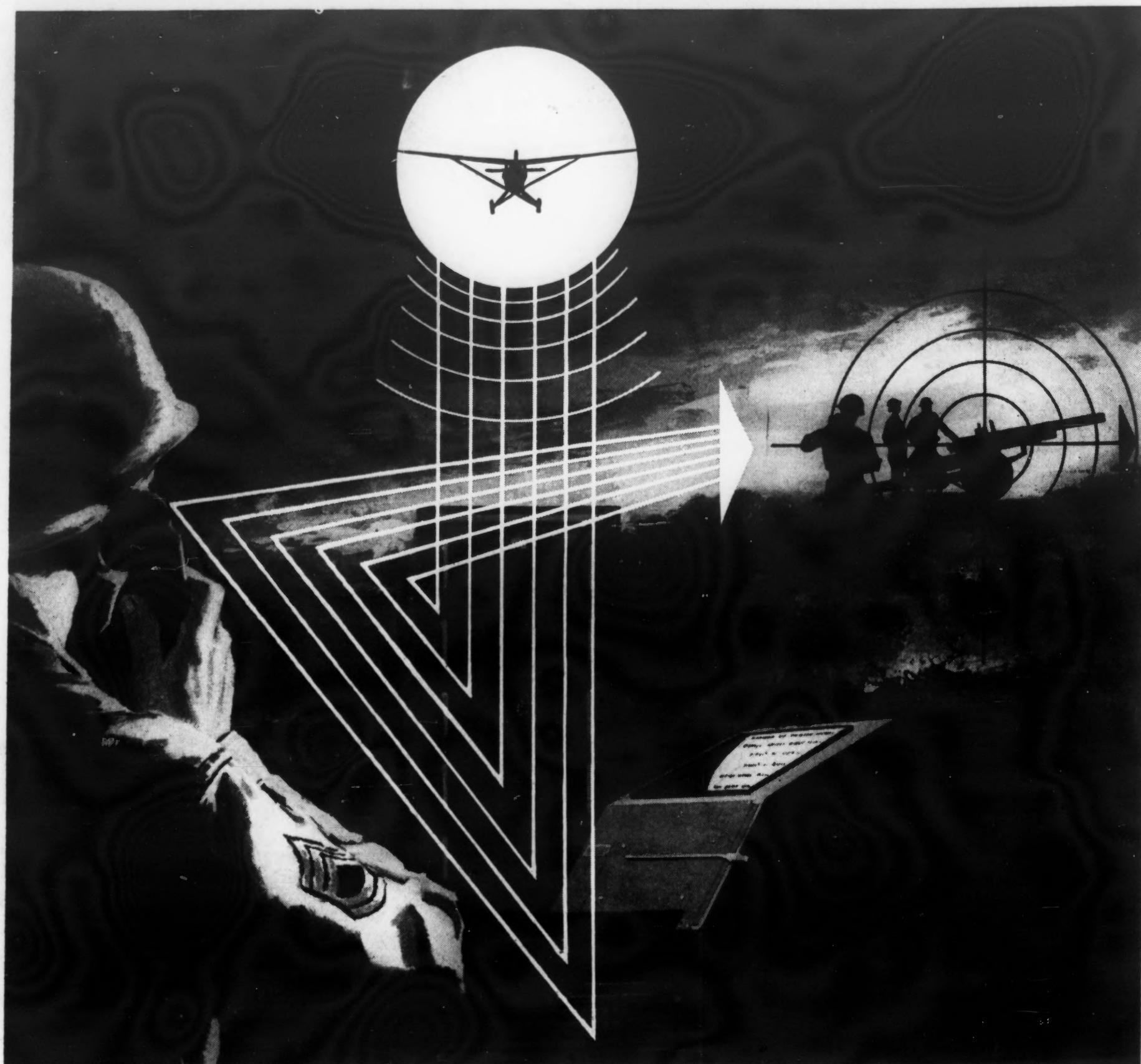
In the field of solid state science it was known—as a laboratory curiosity—that semiconductor diodes can be made not only to convert the frequency of signals, but also to amplify them. At Bell Laboratories Dr. Arthur Uhlir, Jr., and his associates calculated that this amplifying action could be put to practical use. They proved the point by developing a junction diode converter which can deliver up to 40 times as much signal energy as previous converters.

This efficient new converter will be applied in a new Bell System microwave highway able to transmit thousands of telephone conversations and a dozen television programs simultaneously at six billion cycles per second. In other forms it is being developed, under U. S. Army Signal Corps contract, for radar and military communications where more efficient frequency conversion can also be used to advantage.

This development is an example of the many different ways in which the Bell System works to improve your telephone service and communications at large.



### BELL TELEPHONE SYSTEM



## Why **LABIL** is a powerful link in the communications chain

Speed and reliability make LABIL, Stromberg-Carlson's new data link, ideal for automatic transmission of flight information from light aircraft to ground receiving and control locations.

Into the link the pilot or observer can enter 13 types of data regarding flight and target. When the ground control group wants the information, a lamp on the panel of the airborne equipment lights. The pilot or observer presses the transmit key, and the entire stored message is automatically transmitted over his *existing voice communications equipment*.

Greatly increased reliability is achieved by transmitting each character *twice*.

At the receiving end the message is checked for errors

due to noise interference. The error detector examines the two transmissions for complete agreement, then prints the message out on a teletypewriter. Speed of transmission is limited only by the bandwidth of the communications equipment and printout device.

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Complete technical data on Stromberg-Carlson's Light Aircraft Binary Information Link is available on request.

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**BPA**

# SIGNAL

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Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

\*A Stockpile Article.



U. S. ARMY PHOTO

## STRAC-free world minutemen

STRAC — Strategic Army Corps — is the U. S. Army's new combat-ready force designed to meet the initial requirements of limited war or to provide reinforcements to overseas troops in a general war. Its mission is to be operationally ready on a moment's notice to move by air and sea to potential trouble spots anywhere in the world.

Four famous divisions of your modern Army form this highly specialized team — the 1st and 4th Infantry Divisions and the 82nd and 101st Airborne Divisions. Their capabilities are well recorded beside such names as Tunisia, Sicily, Salerno, Anzio, Normandy and Bastogne. Today, these men show their dedication to the preservation of world peace by their readiness to help stop aggressions — anywhere, any time.

Electronic systems — radar, communications, data processing and countermeasures — help STRAC forces get to their objectives swiftly and accomplish their missions efficiently. With the aid of electronics, STRAC is continually "Skilled, Tough, Ready Around the Clock."

*Progress Is Our Most Important Product*

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SYRACUSE, NEW YORK

*The  
President's  
Page*

FREDERICK R. FURTH



**I**T HAS BEEN VERY GRATIFYING to note that many of our chapters have been conducting membership drives in recent months. The reported increase of 66 new members at Fort Monmouth during one month of activity is certainly proof positive of what can be done. Harry Ross reports that this was accomplished through personal contact, taking but a very limited time. This is a record at which other chapters may very well set their sights. I am sure many more individuals in the communications, electronics and photographic industries throughout all sections of the country would be anxious and willing to join the ranks of AFCEA if each local chapter would expend a little more energy on a membership drive. The same is true for enrolling new group members.

The health and success of any organization depends upon steady growth. During the past few years we have shown progress, but our increases have not been in proportion to the rapid expansion of the nation's fast growing electronics industry. We have barely tipped the scales upward. Much of our progress has resulted from a very definite and profound reader interest in SIGNAL Magazine which ranks high in the magazine field. In addition to this, we must concentrate our fire on a personalized campaign to double our individual membership role, to create new chapters and to add to our group member list at least 3 percent of the 4200 companies in electronics and communications.

Besides strengthening the nation's civilian-military team concept, AFCEA provides a meeting ground for the interchange of ideas which not only strengthens the bonds of friendship and fellowship but in many ways contributes to the establishment of a better and more productive America. This productivity resulting from an equality of personal association and the interchange of knowledge is the cornerstone of our future freedom—precisely so, if we are to preserve our heritage against the aggressive production competition of unfriendly nations.

Our productivity in communications, electronics and photography lends itself to an ever-increasing and steady flow of government and civilian business. With the military electronics production alone accounting for over one-half of industry's dollar volume, producers of products and systems can benefit greatly by making themselves and their wares known by advertising regularly in SIGNAL. The benefits which accrue from membership in AFCEA and from advertising in SIGNAL are unparalleled. Since SIGNAL is read by the men who count, this is an opportunity which industry cannot afford to miss.

The following two ideas are worthy of mention. It is essentially important that we rededicate ourselves individually to the task of strengthening our civilian-military relationship which has been the hallmark of our Association since its founding. We cannot afford to rest on our oars and through complacency fail to recognize the importance of enrolling the increasing number of young civilian and military people affiliated with the communications, electronics and photographic industries. Those gentlemen are the leaders of tomorrow. They must be contacted. After all, AFCEA has something to offer and they have something to gain.

Secondly, at our recent National Convention, the necessity of making chapter meetings attractive was an issue foremost in the minds of our chapter presidents. It is the responsibility of each of us to pitch in and assist in making our local programs so outstandingly interesting and informative that everyone will want to attend. Here again, this is something which requires a little added effort and planning, the result of which is repaid a thousandfold. It is suggested that a welcoming committee be on hand at each meeting to greet guests, individuals and group member representatives. In this way they are definitely made to feel that they are a major part of AFCEA. Let us resolve now to strengthen our Association and tip the scales upward in proportion to the expansion of the industries in which we all have a major interest.

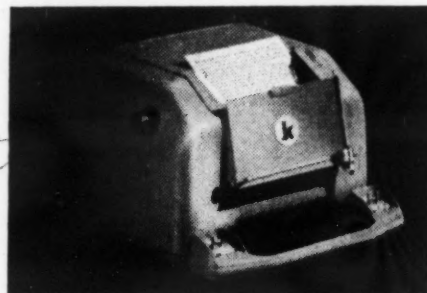
# Communications keyed to the jet age



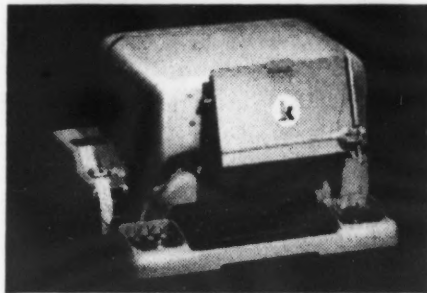
**At U. S. Air Force bases of operation, Kleinschmidt page printers and reperforator teletypewriters receive and transmit printed messages at speeds up to 100 words per minute.**

Instant and precise communications between Air Force bases is a prime requisite in this era of supersonic speeds. To meet this essential need, Kleinschmidt teletypewriters and related equipment, developed in cooperation with the U. S. Army Signal Corps, provide fast transmission and receipt of printed communications. There is no time-lag for interpretation, no chance of misunderstanding, since both sender and recipient have identical printed originals . . . instantly.

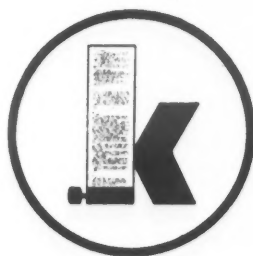
Research and development of equipment for transmitting and receiving printed communications has been a continuing project at Kleinschmidt for almost 60 years. This unparalleled store of experience, now joined with that of Smith-Corona Inc, holds promise of immeasurable new advances in electronic communications.



**Model 150 Page Teleprinter**  
Transmits and receives teleprinted messages at pre-set speeds of 60, 66, 75 or 100 words per minute. Uses roll or fanfold paper. "Semi-rev" operation, whereby shafts rotate only a half-revolution, reduces maintenance, prolongs life of unit.



**Model 120 Typing Reperforator—Tape Transmitter**  
This versatile unit receives and transmits messages in perforated tape form and permits reproduction, editing and preparation of tape, as well as manual keyboard transmission.



# KLEINSCHMIDT

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Pioneer in teleprinted communications systems and equipment since 1911



## THE businessman AND national security

by  
John L. Burns  
President  
Radio Corporation of America

**I**N FACING UP to the short-range threat from Russia, the U. S. Government and particularly the Defense Department must stimulate and encourage our free-enterprise system. They must supply the needed incentives to keep this system healthy and strong for our national security and our way of life depend on it. Government work must be made as attractive to industry as other forms of business activity.

The competition between ourselves and the Russians is a new kind of competition with a new society. It is a classic test of the free-enterprise system versus Marxian socialism. Our task is to put the creativity and productivity of American industry to work as effectively for the military as we have for the consumer.

We are turning out about ten times as many household appliances as the Russians and fifty times as many passenger cars—all of unsurpassed quality.

The total value of the goods and services produced in this country in a year is \$429 billion—between two and three times as much as in Russia.

In our defense effort, we have not taken full advantage of the superb

strengths inherent in our free-enterprise system. We have tried to operate with insufficient incentives and with highly centralized governmental control.

In short, we have tried to whip the Russians with one hand tied behind our back.

If there is to be a free-enterprise approach to our defense requirements, the government in its dealings with business obviously must be guided by the factors that make the system work. These factors include incentive, teamwork, decisiveness, initiative and planning.

When I talk about incentive in connection with the defense effort, I do not want to be misunderstood. I want to make it clear I am not suggesting that we exploit the threat to our national security in order to increase industry's earnings. What I am proposing is something that would be an incentive to industry and would also save the government money. And above all, it would help strengthen our chances for survival.

In our present system, the basic weakness in the lack of incentives is not so much that many people in many companies are not working in

defense. There are many talented people working and, of course, with proper incentives there could be more. But the real losses to us are these:

1. Some of the most effective people in our country are not working on defense or are giving only a portion of their time and thought to it.
2. The profit incentive is insufficient to enable companies to devote a major effort toward research and development work originated by the company itself. Therefore, the full potentialities of free-enterprise in this field of creativity are not realized.

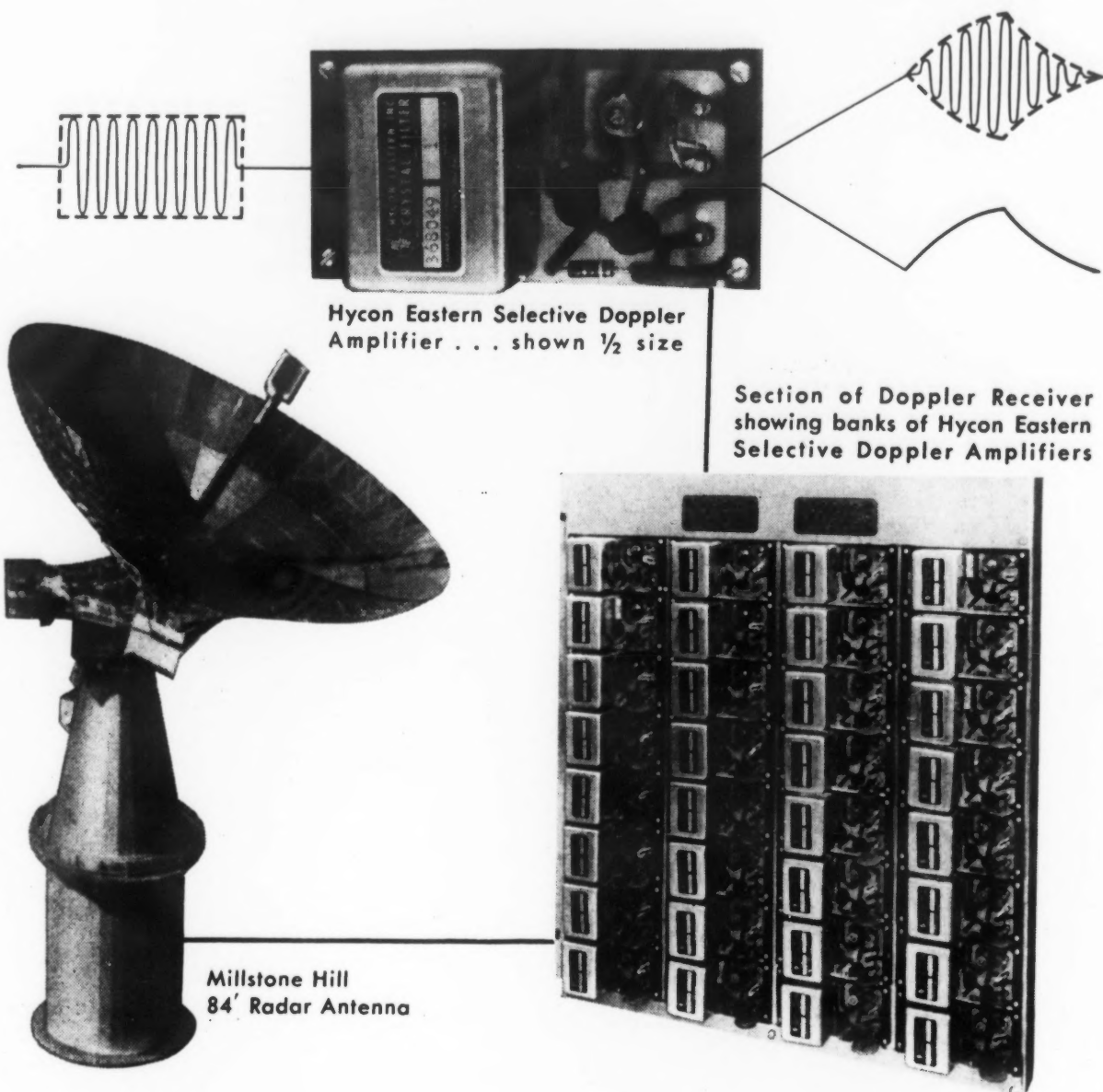
Under the present system, there is a depreciation in incentive even below the level provided by law.

There are two major laws that regulate defense work now. One is the Armed Services Procurement Act of 1947 which authorizes the services to pay contractors their costs plus a fee up to 15 per cent of their costs, as a profit, on research and development contracts. The second law is the Renegotiation Act of 1951 which authorizes the government after one year to take a second look at a company's

## FIRST 1,040 Mile

Pulse Doppler Radar uses

## HYCON EASTERN CRYSTAL FILTERS



The problems in long range radar for today's ballistic missile defense systems require solutions that are unique yet reliable. Meeting these criteria is the Lincoln Laboratory's "Millstone Hill System". Working closely with Lincoln Laboratory on the transient response problems, Hycon Eastern provided "comb set" crystal filters and associated circuitry forming complete networks termed Selective Doppler Amplifiers.

Hycon Eastern offers a unique customer service by assuming total responsibility for exact pulse output. All crystal filters are tested and aligned under simulated operating conditions, using a pulsed input. Transistor amplification, active impedance transformation, and detector circuitry are provided for complete compatibility with the total system. These integrated units are delivered ready for immediate use.

Hycon Eastern is presently supplying crystal filter banks for airborne intercept, bomber defense, shipborne and land based detection and tracking systems. Write for Crystal Filter Bulletin.



### HYCON EASTERN, INC.

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Dept. G

Cambridge 42, Mass.

defense business to see if the profit has been excessive.

The 15 per cent fee, stipulated in the Procurement Act, has been cut back to 10 per cent by the individual services unless the Secretary of the Army, Navy or Air Force makes an exception—and this does not happen very often. In practice moreover, military contracting officers seldom agree even to 10 per cent. It is difficult to negotiate a fee of more than 7 per cent. Even this is subject to further reduction because many of the costs which contractors incur in the course of a job are disallowed. Thus when the contractor is through, his earnings before taxes average about 4 per cent of his sales and after taxes may run as low as 2 per cent. During World War II, there was a compensating factor. Companies got production contracts which, because of their large repetitive volume, made up for the low return on research and the meager percentage allowance on production. Now there is rarely any large-scale production and the allowance figures are the same.

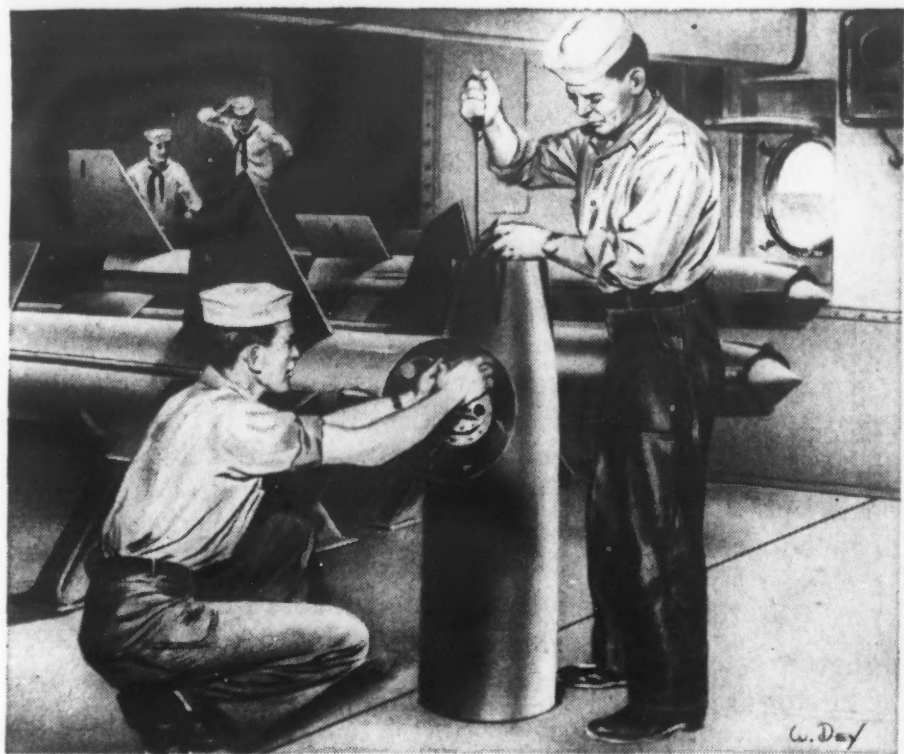
Throughout the present contracting procedure, renegotiation hangs like a sword over the contractor's head. Let me give you an example of what I mean. Suppose that an efficient producer manufactures a defense item and sells it for \$900, making a profit of 15 per cent. Then suppose that an inefficient producer sells the same item for \$1,000 and makes a profit of only 5 per cent. Even though the efficient producer sold the item at a much lower price, it is he and not his inefficient competitor who stands to have his defense profits renegotiated, on the ground that they are "excessive." What we have here, in effect, is a case showing the penalization of a company for actually saving the government some money.

#### Checking Practices

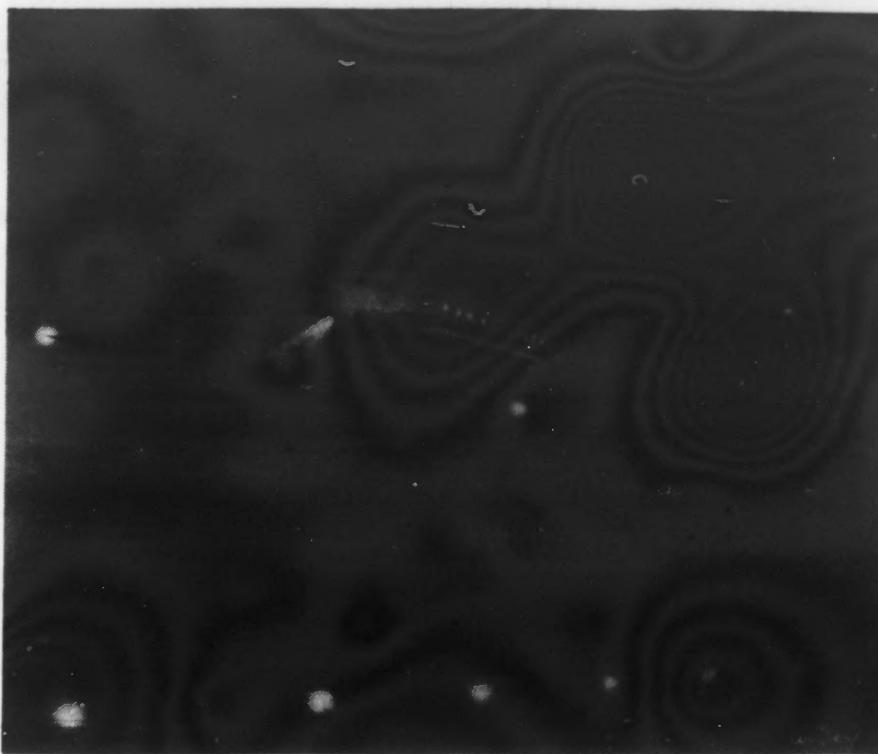
The purpose of the Renegotiation Act is highly commendable. It was drawn up originally during World War II to provide for a review of contracts that were being hurriedly executed under the pressure of a war emergency. But modification of the law is long overdue. The chief danger lies in having too many checks rather than too few.

Businessmen, of course, recognize the need for some controls on defense work. But the control procedure must be tempered with judgment and adjusted to meet varying conditions if we are not to weaken incentive.

The practice of checking, in some instances, has been carried to harmful extremes. For example, one air-



**MISSILE COMPONENTS** Bulova safety and arming systems protect ground, air and sea crews from load to launch, then take over in flight. Safety factor of one in a million is specified and reliably delivered by Bulova's precision production facilities. Powder-driven gyros and fuzing systems are among other Bulova developments for 18 key missiles.



**AIRCRAFT INSTRUMENTS** Bulova's new Servo Altimeter assures maximum reliability through unprecedented sensitivity, accuracy and repeatability. At 40,000 feet, it detects 4-foot changes... is correct to 40 feet. Safety is improved in traffic control and flight over difficult terrain. As a control instrument, it is readily adaptable to guided missiles.

## Bulova reliability helps to solve today's most challenging problems

For more than 80 years, Bulova has charted new courses in the area of reliability.

Milestones along the way are the electronic and electro-mechanical devices created by the Bulova capability—the uncommon blend of pioneering vision and precision production experience.

These Bulova developments, distinguished



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by their advanced design and consistent high performance, help our nation's defense and industry stake solid claims on the frontiers of science and space.

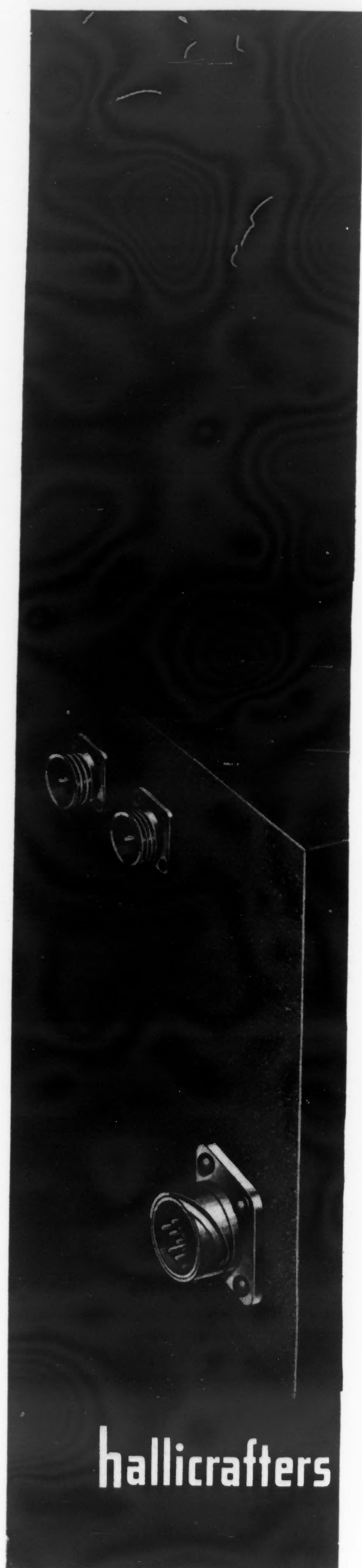
The high degree of Bulova reliability prevails from concept to mass production. For assistance with your systems and components problems, write: *Department G.I.S. 3, Bulova Park, Jackson Heights, New York.*



**INFRA-RED COMPONENTS** Bulova infra-red cells are designed to unerringly guide Sidewinders to target. Bulova-improved production processes increase yield and product reliability. Other infra-red developments include filters, reticles and thermistor bolometers, as well as advanced research in mosaic and lead selenide cells.



**PHOTOGRAPHIC SYSTEMS** Bulova's new high performance 70mm recon-camera features 8 frame/sec. and pulse operation...vibration-free exposures to 1/4000 sec. From the smallest 16mm gun camera ever built to units of 9x18" format size, Bulova developments include optical, data recording and instrumentation, and special sequence cameras.



craft company estimates that fully one-third of its technical staff is needed to cope with government paperwork. It devotes upwards of 400,000 man-hours a year to preparing reports for a long list of federal agencies. Instead of writing reports and serving on reviewing committees, these scientists and engineers could be far more productively employed in gaining new knowledge through research.

While we are considering the matter of incentive, let's remember that this concept applies to those working in government and the Armed Forces as well as to those in business.

When George Washington came to Cambridge to take over the Continental Army Command, he understood very well the principle of paying men to fight. However, it remained a continuous problem with him throughout the Revolutionary War to convince Congress and the States that they should live up to their pledges of providing pay, equipment, supplies and special benefits for soldiers.

Prior to World War II, our military services were predicated on the traditional lines of land and sea forces operating relatively independently. The services were made up of a comparatively small corps of professional personnel on the assumption that these people and the meager resources furnished them would provide a nucleus around which our fighting forces could be rebuilt in an emergency, as they were in World War I. The advent of modern weapons such as the airplane, the ballistic missile and the atomic weapon has changed all of this. We now find it necessary to maintain a very large standing Army, Navy and Air Force comprised in each case of highly skilled personnel, with the majority of them serving on a career basis.

Today, our military career men are not paid what they should be, with the result that some of the most competent officers are resigning from the services. Many of these men in the prime of their years are leaving to join the major corporations because of the financial situation in which they and their families find themselves.

The new military pay law, based on the recommendations of the Cordiner Report, represents a step in the right direction and one for which Congress and the Defense Department deserve congratulations. But a great deal more remains to be done if we are to match the Russians in

providing incentive for our key people.

### Role of Business

If we are to achieve maximum effectiveness in defense, the role of business—both large and small—must be better understood.

In our free-enterprise system, we need big and small business working together to turn out the good that each produces most efficiently. We need big business for its massive scientific and technical resources and its ability to produce in large volume. We need small business for its specialized skills and its initiative in developing new ideas. Without one, the other would wither on the vine.

Both are especially necessary in our defense effort. The large companies perform a valuable function by taking on major projects and then breaking them down into segments that are manageable by smaller firms.

In two world wars, large companies have been one of the basic sources of American strength. During World War II, the 100 largest contractors handled two-thirds of our critical defense production. In the present age of ballistic missiles and hydrogen warheads, when it costs anywhere from \$50,000 to \$150,000 just to make a proposal on a major defense contract, only companies with large budgets can afford to go after the big prime contracts.

How would we like to prepare our defense without the aid of the top three or four companies in steel, motors, electrical equipment, chemicals, aircraft and other key industries?

David E. Lilienthal, in his book *Big Business: A New Era*, tells how the government turned to a big business for help in mass-producing atomic bombs. And then he makes this comment: "To the extent that the principle of Bigness, in our economic life, contributes in an affirmative and an indispensable way to the strengthening of our national security we should, by an explicit and affirmative national policy, encourage and protect that kind of Bigness."

There has been a multitude of misconceptions about the relationship between big and small business. The charge has been made that big business has prospered by stifling small business. Nothing could be further from the truth. The Rockefeller Report on the U.S. economy points out that the total number of businesses in this country has grown by 40 per cent since 1929—even while individual business units have become larger. We now have 4.2 million non-farm

businesses in the United States—the largest total in our history. This is a pretty good indication, I think, that there is no stifling of small business and no shortage of the spirit of enterprise that has made America great.

I am not for big business or for small business as such—I am for maximum effectiveness. Whatever it takes—if it is good for the consumer and our people generally, and if it is good for our defense—let's do it! Let's do it with big *and* small business!

To attain maximum effectiveness in our defense program, we must exert every effort to reduce lead-time—the lag between the conception of a weapons system and its actual production.

A Pentagon study group\* found that, on the average, it takes us ten years to conceive and produce new air-weapons systems—about twice as long as the Russians. The group also found that half of our time is spent trying to decide whether to go ahead with the weapon or not. In other words, it takes us as long to plan a new system as it takes the Russians to plan and produce it.

The problem is complex but improvements can—and must—be made.

Business' approach should take into consideration all the elements of sound management—planning, organization, integration and measurement. There is a natural tendency to keep doing things the way we did them yesterday. Business must be willing to experiment constantly with new techniques and adopt them whenever these techniques can improve on existing methods.

On the other hand, government should give business greater authority and responsibility for making decisions on materials, components and techniques. There have been some encouraging advances in this direction just in recent months and it is to be hoped that this trend will continue. For one of the prime strengths of the private enterprise system lies in the creativity of individual contractors.

We must remember that any decision about new weapons carries with it a certain risk. We must accept this risk and use our best judgment on when to "freeze" major product designs and go into production. There are bound to be some mistakes. But this is part of the price we must pay to close the gap between ourselves and the Russians on lead-time—and this gap *must* be closed.

\*Ad Hoc Study Group on Manned Aircraft Systems appointed by Defense Secretary Wilson in 1957.

In facing up to the long-range threat to our security, we must adapt ourselves to a situation which, for us, is entirely new. Throughout our history as a nation, we have grown accustomed to looking upon war as one thing and peace as another—and adjusting our national policies accordingly.

Now we find ourselves confronted with a situation that is neither full war nor full peace but Cold War—or Hot Peace. One difference between Cold War and Hot War is that no one has quite pulled the trigger. Another difference is that recent Hot Wars have been of limited duration; Cold War may last for generations—a throw back time-wise to the days of the 14th and 15th centuries when the Hundred Years War and The Wars of Roses raged on seemingly without end.

Because of the permanency of the crisis and the complexity of the problems inherent in it, this Cold War situation calls for a new approach to over-all, long-range planning. We must establish farsighted objectives and plans which will not be affected in a major way by short-term considerations.

How can we accomplish these aims without giving up those things we hold dear?

This is the most important question of our time.

While I do not claim to be an expert on the subject, I believe we need new and fresh approaches to the solution of our Cold War problem. I believe that each of us should try to suggest such approaches. We must lift our eyes to a more distant horizon.

In this spirit, I would like to suggest a possible approach to this problem.

I believe we should establish a fourth major branch of our Federal Government—one that might be called the Permanent Council on Plans and Policies. This new branch—ranking in importance with the legislative, executive and judicial branches—would have responsibility for over-all planning.

The legislative and judicial branches have reasonable continuity but the executive branch does not. The President has, at most, eight years in the White House. The average term of a cabinet officer in the last three administrations has been 3.7 years. In these circumstances, there is little chance for continuous study and analysis of the fundamental problems that will confront us five, ten or twenty



hallicrafters

ty years from now—or the best policies for coping with these problems.

This would be the task of the Permanent Council on Plans and Policies. Council members would be appointed for extended terms, in much the same manner as our present Supreme Court members, by joint agreement of the executive branch and Congress. Hence, they would not be subject to the varying fortunes of political parties. They would be selected from among top-ranking leaders in education, the sciences, business management, defense, labor and other important segments of national activity. They would be supported by an adequate staff of specialists.

#### **Task of New Branch**

The primary function of this Permanent Council would be to formulate our long-range objectives, policies, programs and strategy as related to the total needs of the nation. Unlike the other three branches of government, this new one would look primarily to the future.

The difference between this Permanent Council and existing planning groups like the National Security Council, the Office of Defense Mobilization and others would be that the latter ones are all arms of the executive branch and are concerned with a particular area rather than with the over-all picture. The proposed new Permanent Council, being in itself a fourth arm of government, would have the independence and continuity that existing bodies lack. It would also encompass the whole broad range of government activity.

Although it would have the right only to evaluate programs, to recommend their implementation and to persuade the other three branches of government, it is my deep conviction that, in time, the new concepts and ideas emerging from such a top-level group would stimulate greater leadership and direction at all levels of our society. The council would serve to inspire and coordinate long and short-range planning in all branches of government.

While it is true that the Russians pose the primary threat, I believe this program should also be implemented because of the over-all needs of the country. The increasing complexity of our moral, political, economic, military and social problems requires that we be ready to modify our methods and programs when necessary.

Because of their own experience, business executives have the utmost sympathy for the government's tremendous problems in adjusting meth-

ods and programs. Nevertheless, this sympathy must not retard our efforts to point up and solve these problems.

I realize, of course, the time and effort involved in establishing a fourth branch of government such as I am proposing. It would require action by Congress as well as by the individual states.

However, so urgent is the need for our having a coordinated policy on every Cold War front that I would make one further suggestion as an interim move. I would urge that our over-all planning group be set up immediately by executive order. In that way we would begin deriving the benefits at once, while steps were under way to make the council a constitutional agency.

There are other specific steps that could be taken promptly by both government and business. These steps, I believe, would contribute materially to achieving the changes needed in our defense posture, both short-range and long-range.

#### **Steps by Business:**

1. Become acquainted to the fullest possible extent with the nation's military establishment to the end that national security requirements, present and future, are understood.
2. Take the initiative in identifying, defining, studying and solving the problems now facing our military establishment.
3. Come up with better equipment and better procedures to meet our military needs.
4. Make better utilization of industry's engineers.
5. Make available more and increasingly better scientific, technical and managerial people for service with the Department of Defense and the Armed Forces and allow them to serve for more than the one-year period that has become standard.
6. Offer training programs in technical and managerial skills for military personnel to help develop a better understanding of the way business operates.
7. Voluntarily go after cost reduction with resolution, even though it may mean less profit.
8. Do the best job possible regardless of any limitations on incentives.

#### **Steps by the Government:**

1. Devise defense contract terms that will offer genuine incentives for cost reduction, early delivery and peak efficiency.
2. Allow defense contractors the reasonable rates of profit which

were intended and provided by the law in order to make defense work adequately attractive in a free economy.

3. Reimburse contractors for all legitimate costs incurred on a job, instead of ruling out such charges as interest, accelerated amortization of facilities and similar items.
4. Encourage business to do independent research and development of its own origination, thereby releasing the great forces available through the decentralization of brain power and genius.

The new approaches I have suggested—both for the short-run and for the long-run—must be made within the exhilarating frame-work of the free-enterprise system, a system that has brought about remarkable advances in our material welfare.

In its propaganda, Russia has boasted of its economic approach as a great triumph of advanced thinking. In practice, our system is actually the one that has brought about the highest standard of living in the world, while the Russian system is leading its people back toward serfdom.

It is one of the dramatic ironies of history that Karl Marx's socialist goal of abundance for all in a "classless society" has been achieved by the very capitalistic system the collapse of which he forecast as "inevitable."

If we consider the spread in wages between the least and the most skilled workers, we find that in Russia those at the top of the ladder have a take-home pay 80 times as great as those at the bottom. In the United States, the ratio is barely 10 to 1.

While we in America want abundance for all, we must remember that this will never be permanently achieved by reducing the rewards to our most skilled people, whether worker, manager, soldier, engineer or any other occupation.

The *Communist Manifesto* of Marx and Friedrich Engels opened with the portentous words: "A specter is haunting Europe—the specter of Communism."

Today this specter grimly haunts not only Europe but the entire world—a world weary of Cold War and worried about a Hot War.

The challenge to us is plain and pointed.

We must set ourselves resolutely to the task. For in this competition, we must stay ahead—if we are to stay alive.



## BURROUGHS "VEST POCKET CREW" PACKS A TRIPLE WALLOP

AIRBORNE DIGITAL ELECTRONIC COMPUTER WILL "TAKE OVER" FOR PILOT, NAVIGATOR AND BOMBARDIER ON NAVY'S NEWEST JET BOMBERS. The crowded quarters of carrier-based aircraft leave little room for electronic "brains"—a scant few cubic feet in the case of the Navy's requirement for its AN ASB-8 program: a package computer capable of target-approach pilotage, navigation and precision bombardment. And that's just what Burroughs, working closely with the Naval Ordnance Test Station, China Lake, is doing—cutting a roomful of equipment down to size. Burroughs Corporation, 6071 Second Avenue, Detroit 32, Michigan.



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"NEW DIMENSIONS / in computation for military systems"

# communications

AND THE



# commander

GENERAL OF THE ARMY OMAR BRADLEY once said: "Congress can make a General, but communications makes him a Commanding General." While General Bradley was speaking of the battlefield of World War II, his observation is even more true when applied to any future atomic battlefield! It is almost axiomatic that atomic warfare will make the commander entirely dependent upon his communications.

The very nature of atomic warfare, its wide dispersion, great mobility and devastating firepower, makes command most difficult. There are those who believe that the commander can no longer influence the course of battle by a personal appearance in some critical area of the battlefield, that control of widely separated and fast moving maneuver elements without adequate communications is inconceivable. In future tactics requiring greater dispersion and greater mobility, the commander will be forced to remain more stationary. The probability is that the future commander will have to remain at an operations center to obtain an integrated picture of the battle as it develops. From this position, he can exercise his influence on the action by making a quick estimate of the situation and by rapidly communicating his decisions to all combat elements. Regardless of whether the commander remains at an operations center or makes appearances throughout the battle area, he commands only to the degree that he can communicate.

With such a large dependence upon communications, the commander must have a communications system that meets the requirements of reliability, speed and security.

Reliability, the paramount requirement in all situations, means getting intelligence through to all intended addressees in accurate form. It implies the ability to do so at all times and under all circumstances. Reliability must never be sacrificed for other considerations. While speed and security, the other two requirements, are always desirable, they may be sacrificed, one for the other, depending upon the tactical situation. Of course, the ideal system is one which continually meets all three require-

by

Maj. Walter Mulé  
Acting Chief  
Applied Communications Division  
U. S. Army Signal School  
Fort Monmouth, N. J.

ments at all times. This places a big order upon a communications system that must cover great distances, tie in fast-moving units and face extensive damage through atomic fire. Obviously, such a communications system can be created only by meticulous planning.

Just as the principles of war guide the formulation of a tactical plan, we must have principles of communications to guide the formulation of the signal plan. We often find that we cannot apply all the principles of war to a given operation. It may often be impossible to apply all the principles of communications to the engineering of a communications system. Application of the principles does not insure success, but it does increase the probability of success. With this thought in mind, the following principles of communications are proposed as guidelines to achieving a reliable, fast and secure system for tomorrow's commander.

## Nine Principles

- **Alternate Facilities:** Leadership was once defined as preparing for eventualities before they occur. The successful tactical commander prepares alternate plans. The same idea is a must for communications. Alternate routes must be provided in the event of failure of a single route. Alternate equipments, facilities and means must be provided for the emergencies that will occur. An alternate route insures continuity of service when a single route is knocked out by enemy action. It is not only enemy action that creates the emergencies. Electronic equipment cannot be expected to continue operating day after day absorbing the shocks of battle and the rough handling of frequent movement without something going wrong. Or, sudden surges in traffic brought on by the tactical situation may completely overload a single route. An alternate route can be used to bleed off the "backlog."

- **Mobility:** The components of a system for the atomic battlefield must have the ability to change location as rapidly as the combat elements they serve. The mobility of the combat elements must not be restricted because the communications system can not keep up with them. Displacement of the combat units must not deprive them of communications prior to, during or immediately after employment or redeployment. It is essential that communications be adequate during all phases of tactical operations.

- **Cooperation:** No communications system ever exists as a complete, separate entity. Each must be integrated into adjacent systems, into systems of higher commands and into systems of lower commands. At the points of integration the systems must be compatible. They must be joined at alternate points to prevent isolation of one system from the other by a failure at a single point. The principle implies that there will be no interference between adjacent systems and higher and lower systems because of incompatibility or improper radio frequency assignments.

- **Coverage:** The application of this principle means that communications will be furnished to all units and individuals who require it for the accomplishment of the mission. No individual or unit requiring communications must be deprived of the ability to communicate.

- **Economy of Facilities:** Just as the principle of economy of force requires that we assign only the amount of firepower and mass required for a given mission, this principle demands a similar economy in communications. We must assign the proper caliber of yield to a fire mission;

(Continued on page 31)

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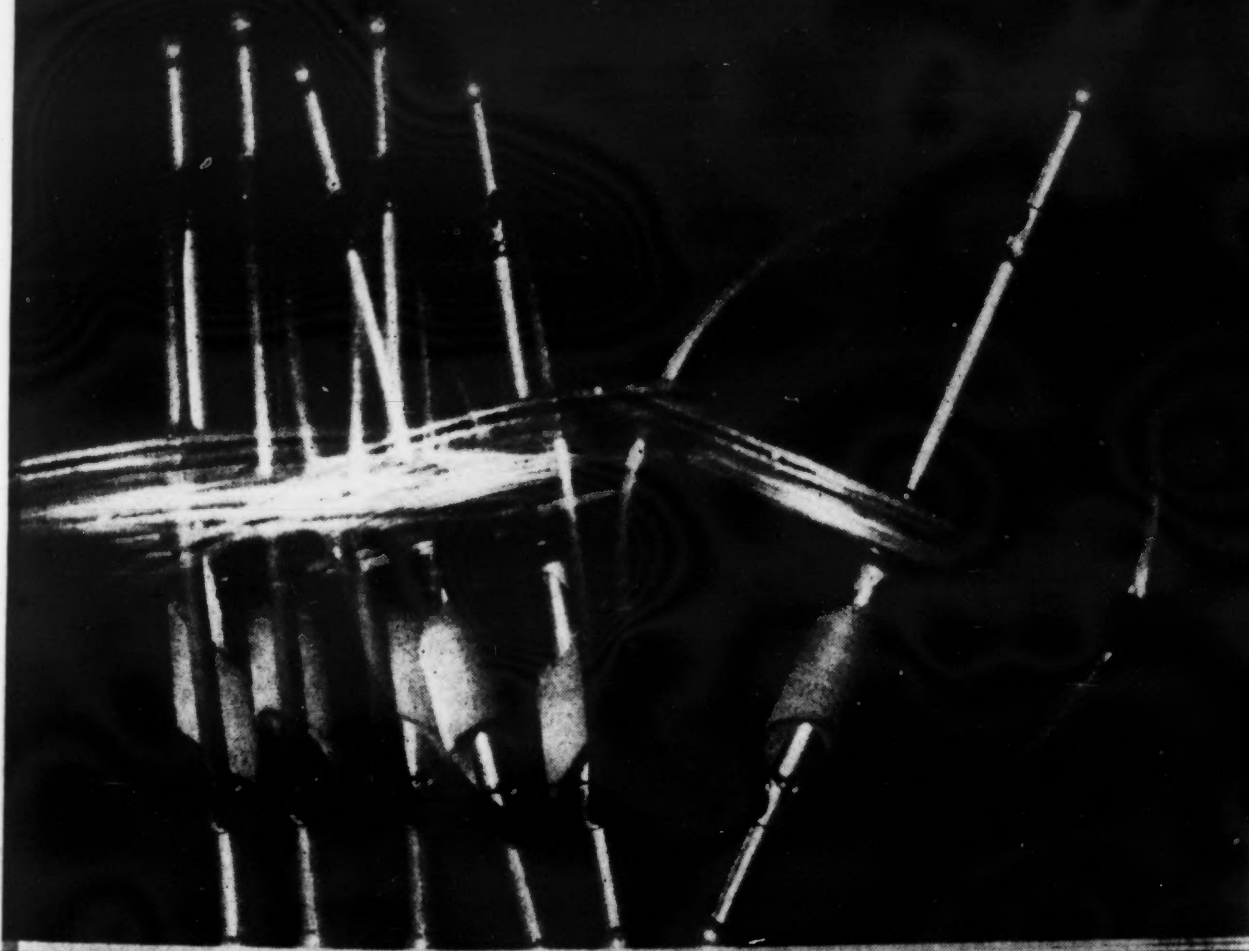
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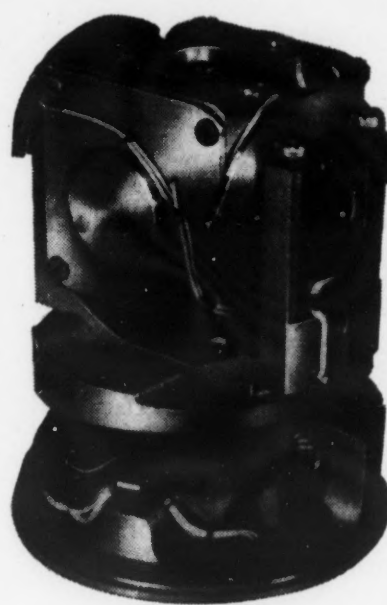
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# GYROS



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# STANDARDIZATION



by Robert C. Sprague

HAVING BEEN ASSOCIATED for over thirty years with a segment of an industry which depends largely upon standards in its daily activities, it seemed that some comments reflecting our experiences and observations might be of interest.

The progress and contributions of the National Bureau of Standards since its establishment in 1901 have been so numerous and important to the industrial and military welfare of our country that one hardly dares refer to any one accomplishment for fear of slighting other equally significant achievements.

With reference to the electrical industry, I look upon the Bureau's activities in two broad time scales. During the first fifty years of its existence, the major portion of the standards effort was successfully devoted to the establishment of basic *electrical* parameter standards, including volts, amperes, time, capacitance, inductance and resistance. For the second half of the century, a large percentage of effort in this area will be concerned with electronics, where rapid technological progress in higher frequencies, semi-conductor behavior, radio wave propagation and many other phenomena makes a serious problem area increasingly more difficult and, fortunately, more stimulating.

## *Electrical Parameters*

In the field of basic electrical parameters, standardization had an early start. Some of the first work was of amazingly high quality. Groups of Edward Weston's cadmium cells, dating back to 1906, are still being used as primary voltage standards by NBS and appear to have an endless career.

Now there are three essentials required of a standard to have it universally accepted and of maximum use. These are:

- (1) It must be capable of yielding consistent results over an indefinite, long period.
- (2) It must be independent of the test operator and of the test apparatus.
- (3) It must yield results that are significant with respect to the final performance of the part or process when placed in service.

These three requirements point up areas of great difficulty in the establishment of good standards and give direction to the improvement of existing ones.

A corollary to the third requirement (that a standard must yield significant results) is that a standard test method should provide the test sample with an electrical environment that is as nearly like its end use environment as practically possible.

Although progress in the field of fundamental capacitance, inductance and resistance measurement has developed to a very high degree since the days of Volta and Faraday, I would like to point out that we must continue serious work in these basic areas.

Development of capacitance standards may appear to be rather unsophisticated when compared to the important programs in low temperature nuclear polarization, in atomic standards of frequency and time and

*Mr. Sprague is Chairman of the Board, Sprague Electric Company and chairman of the former Gaither group on national defense problems.*

in upper atmospheric phenomena. Yet capacitance standards are still the backbone of an industry whose gross annual product value exceeds \$200,000,000. Capacitors themselves are one of the basic components around which a 7½ billion dollar industry has developed.

Secondary mica capacitor standards underwent a major improvement 20 years ago with the introduction of silvered mica. Before that, aging of the only available mica capacitors, the stacked foil variety, was very slow. Even after aging, stability was not adequate because of increased foil surface area resulting from a gradual flow of foil material into the mica. Today's industry and defense requirements would find such a standard intolerable. With the advent of the silvered mica standards, methods were developed to accelerate aging, while other designs have improved stability considerably. In addition, leakage resistances and dissipation factors have been improved several hundred percent.

But this is only part of the story. Right now, secondary capacitance standards are available in values of the order of one microfarad, as a maximum. Even so, there is a dearth of reference standards for small *phase angles* in the order of one ten thousandth of a radian. As of this date, the most precise calibration equipment available can give small phase angle accuracies of but 5% to 200% for audio frequencies applied to capacitors up to one microfarad. With the trend of electronic design creating the need for production-line components with near-theoretical characteristics, the development of these low power factor standards must come and must come soon.

In the field of basic parameter standards, it is necessary to develop materials and components of greater stability than those in general use today in order to give a greater assurance of the long-term stability of the standards themselves. The development of such reference standards is already past due. For example, with today's electronics industry requiring production runs of capacitors with an accuracy of one tenth of one percent, it is no longer adequate to have capacitor standards of three one-hundredths of one percent stability. And yet, in general, commonly accepted capacitor reference standards do not have a stability which would warrant certification to a closer figure than this. In fact, it is possible to obtain measuring equipment with a stability equal to or better than the stability of the reference standard. Such equipment is being only partially utilized because it lacks the proper standards.

Another area in which we are approaching a serious deficiency of adequate primary and secondary standards is in high capacitance values. With the advent of large transistorized computers, highly regulated, low impedance power supplies are absolutely essential. And to produce them, electrolytic filter capacitor banks are being used with values of capacity as high as 100,000 microfarads—that is, one tenth of a farad. The scientists in my company are well into a development program which will result in one farad capacitors—a million times the capacitance value of our secondary standards.

Although precision of capacity value at the one farad level presently need not be great, we must know the loss angle as this represents the series resistance of the unit in its application. For example, high series resistance, even one hundredth of an ohm, severely limits the effectiveness of the capacitor in its theoretical function. Now, use of ratio arm bridges of the conventional type, in which the reference standard is one millionth that of the test capacitor, obviously will not permit the determination of even reasonably accurate capacitance and loss values.

Although the art associated with the making of paper dielectric capacitors goes back forty years or more, only recently has work been completed within the A.S.T.M. which has made possible a standard for Kraft tissue dielectric paper. In the course of this development, it was discovered that there were many ways already known for measuring dielectric con-

stant, dissipation factor and expected life, with only a few of these giving comparable results. Demand for such a standard test method comes about because of the substantial improvement in the reliability of capacitors used in large numbers, both in military and civilian applications.

Now that industry has this standard test method for paper capacitor tissue, we have to review capabilities for developing standards for newer dielectrics, such as mylar and polystyrene films, both of which are becoming much more widely used and will eventually rival paper in importance as a basic dielectric for capacitors.

Specific resistance standards have also shown vast improvement. In 1930, Dr. James L. Thomas described a one ohm standard having a stability of one part per million over a 10-year period. This provided a resistance standard 10 times more stable than the Rosa coils then in use.

We cannot speak of standards without mentioning the measuring devices used to calibrate these standards. The mutually coupled ratio arm bridge shows great promise. Its practicability has been demonstrated in recent years—and it may very well be the basic measuring device that can best utilize future high precision standards calibrated against NBS standards, some of which have a calibration accuracy of one ten-thousandth of one percent. This is indeed a fantastic accuracy. And it illustrates well the great forward strides taken in recent years.

But despite such progress, the rapid advancement of the entire state of the electronic art since World War II has spotlighted an increasingly urgent need for more comprehensive and even more precise standards, terminology and measuring methods. These are the challenging areas that I mentioned earlier for the second half of this century.

#### Electronics

The NBS program in standards for electronics is generally advancing on a broad technical front. In some specific areas, however, further attention is needed to support the mushrooming, highly technical electronic data processing industry.

I have specific reference to the magnetic components used for memory elements, memory driving and switching transformers and logical devices such as shift registers. Each of these critical elements employs an approximately square loop type magnetic material, usually in the form of a toroid. The material, itself, may be

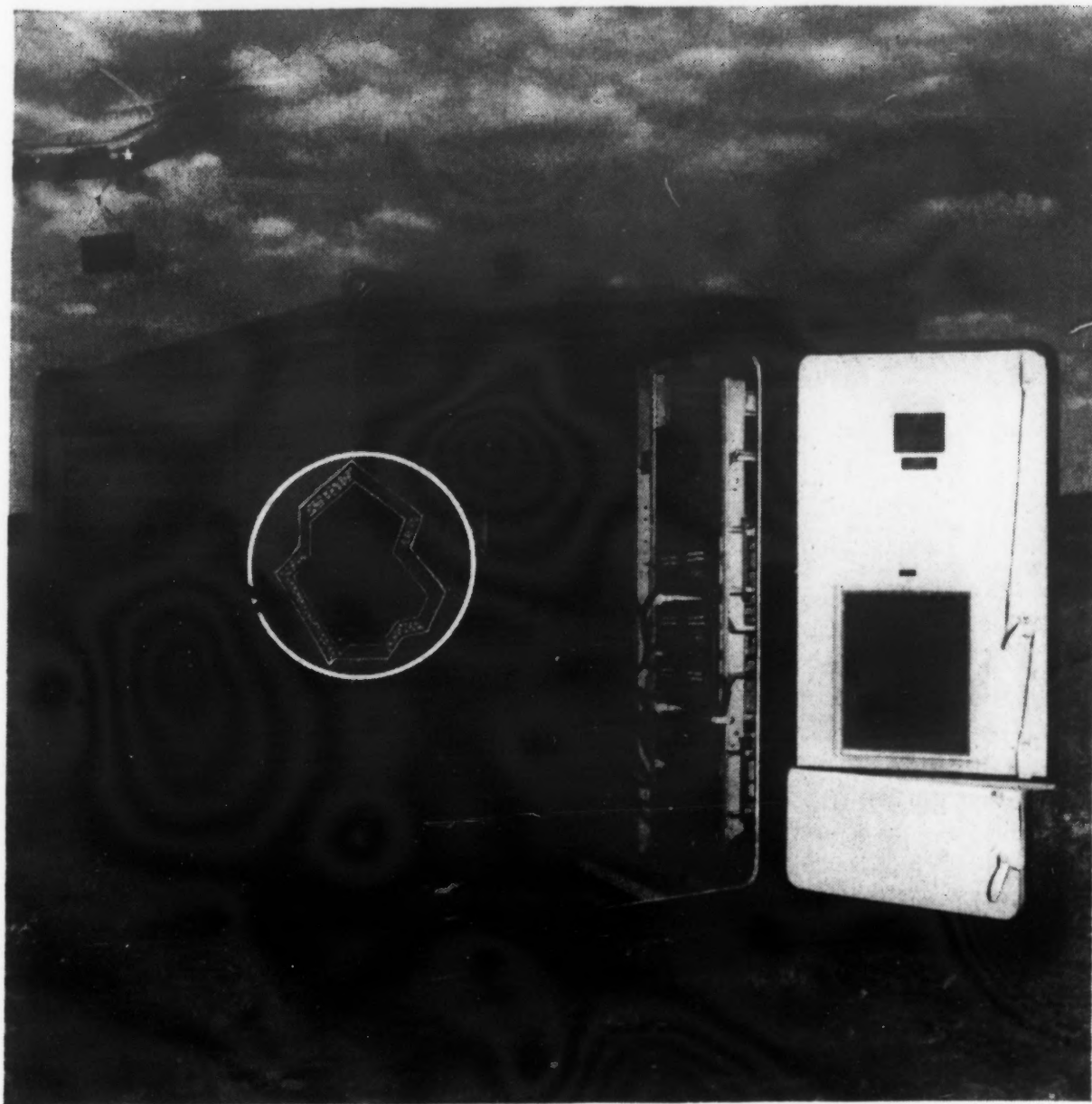
a ferrite or a metal tape made of one of the molybdenum-permalloy alloys. As you well recognize, the operation of these elements depends upon the application of a pulse of energy and the output is also a pulse energy. This is in distinct contrast to the DC and 60-cycle energy previously applied to materials of this sort. We have found that the DC and low frequency AC characteristics of the basic magnetic materials have no direct bearing on the behavior under pulse conditions, in which relatively steep wave fronts are present. Lack of this knowledge and of standards for comparison and calibration, as well as an almost complete lack of standardization in measurement equipment, has resulted in what I hope is only temporary use of almost empirical type procedures. Perhaps this would not be a serious problem if one employed elements of this type as individuals or in combinations of five or ten. In the computers, however, where the amount of data to be processed can involve millions of bits, many thousands of these individual elements are commonly used together.

It is found that although the individual output of such a single device needs only to be what is called a one or a zero, each of which may have a relatively broad tolerance, the effect of these tolerances is *additive*. Thus, if the zero output of a single core is only 5% of the one output, a series connected string of such cores may well develop a spurious one signal. While this may only happen once in a million operations, it absolutely defeats the whole purpose of the computer and, in an extreme example, might direct a defense missile against the wrong target.

So I feel that pulse characteristics of magnetic materials represent an area in which standards are badly needed, both in measurement technique and in the standard element itself. At the same time, one must recognize that little progress can be made in a permanent way until standards of terminology are defined.

For example, when an engineer refers to rise or fall time, he must at the same time define his terms. Are they measured at the ten percent—ninety percent amplitude points or at zero percent—one hundred percent? When he speaks of pulse width, does he measure it at the base line or the fifty percent amplitude level?

Actually, tremendous effort is being put into the development of better methods for testing computer type magnetic cores. In this work, every



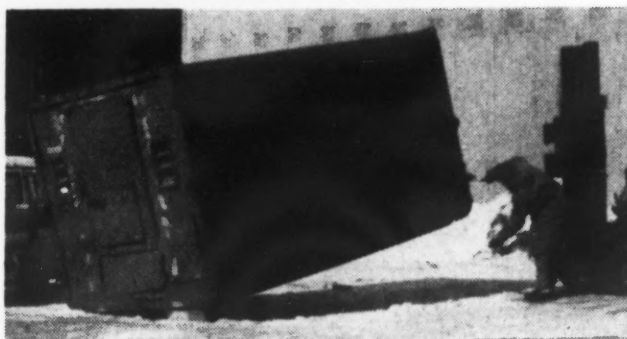
## POURED-IN-PLACE FOAM and THE CRAIG HELICOP-HUT\*

The term Helicop-Hut\* is a copyrighted trademark name that stands for the original of the design of a Craig shelter using a combination of poured-in-place foaming processes, high tensile aluminum sheet and extrusions, and Epoxy Resins to achieve the optimum of insulation "K" factor, ruggedness and lightness in weight. This type of foam construction is non-hygroscopic, non-nutrient to fungus, and capable of withstanding severe thermal shock. A two-inch thick aluminum-faced panel has an insulation "K" factor of 0.115.

Developed and perfected by Craig engineers over the past four years, these foaming processes and fabrication techniques, together with the details of structural design, are now being incorporated into an increasing number of shelters built to military specifications, including S-97, S-98, S-118, S-138, S-141, S-144, S-152 and S-155.

You get this kind of built-in reliability only from Craig. And you find it in *all* Craig shelters and vans, from tactical communication and navigation centers to missile firing, sighting, and checkout stations.

*Also worth remembering:* Craig production schedules are geared for early delivery — prototype or production. For complete information, write or phone:



*Strength and ruggedness of foamed-in-place plastic and aluminum construction is illustrated by this rotational end drop test of Craig Model 129 Helicop-Hut\* with 6,000 pound payload.*

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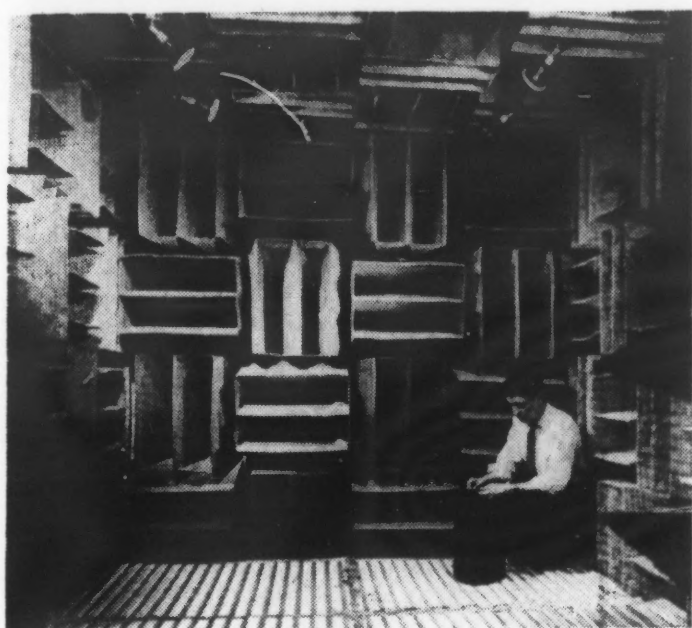
possible kind of problem has arisen. The electrical loads a core support and the driving forces it experiences in a shift register circuit, pulse transformer or memory plane, are highly complex. The test fixture must accommodate extremely small cores while at the same time isolating the electric fields of the "drive" windings from the electric fields of the "sense" windings. At first, the small sensing signals could not be measured or characterized to a high degree of accuracy until integrators and calibrators were designed. Since this was a new frontier of electronic application, the electrical driving equipment that possessed the required ranges of pulse amplitudes, widths and stability was not available. Even today we are still concerned with the detrimental effects of the earth's magnetic fields on the extremely small signals involved.

While on the subject of pulse measurements, let me say this about the primary measuring device—the oscilloscope. Although not a standard in itself, the oscilloscope is utilized in lieu of more adequate standards. However, the oscilloscope of today falls far short of the requirements of the people who use it. These people need greater stability, higher frequency range and greater trace definition. Oscilloscope manufacturers contend that today's instrument incorporates the maximum number of vacuum tubes commensurate with acceptable reliability. To date, it has not been found practicable to increase cathode ray tube diameter from its present usual five inches. This is because the trace width increases in larger tubes thus defeating the purpose of the increased viewing area.

I have tried to summarize two of the problem areas with which I am familiar. I am certain that they represent but a very small share of the total problems in the electrical area and, of course, but a minuscule part of the over-all national and international standardization of physical quantities.

The challenge facing us in the standardization field cannot be minimized. We have advanced the art beyond the wildest dreams of Volta and Ohm. Now our continued progress in the research and development fields depends primarily upon standardized terminology, adequate basic standards and standardized precision measuring devices. We cannot go forward without a firm and comprehensive foundation. To give us that foundation is the mission of the National Bureau of Standards.

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*Specially designed anechoic chamber, used for measurement of sound without reflection or reverberation in the CBS Laboratories Research Center, Stamford, Conn.*

# RESEARCH

a mark of growth & quality

BY ROY W. JOHNSON

Director, Advanced Research Projects Agency  
Department of Defense

PERHAPS NOT SINCE THE Renaissance has mankind been so devoted to progress. The word itself has taken on an aura of greatness. For there is a stirring in the hearts of free men, there is a whisper of the future, an anticipation that a great era of discovery is upon us, that basic truths of the universe are about to be revealed.

I suppose this has all come about because man has emulated nature and the deed of his Creator in putting new moons high in the skies. He has accomplished the incredible. He has equalled the force of a heaven-made gravity with the force of an earth-made gravity with the force of an earth-made rocket. And like a child just learning to walk, he is thrilled by his steps into the cosmos.

He is understandably excited by each new demonstration of scientific advancement in that spotlighted place that is space. World-wide enthusiasm over these endeavors has brought an insatiable desire to understand phenomena and theories once taken for granted. Science has come into its own—and into the home. Scientific discourses on the nature of the universe and the theory of relativity have been recorded for playback in the living room. While this education is to be commended, let no one get the idea that scientific progress can be generated from an easy chair. It is rather the painstaking attention to detail, the curiosity, patience, and determination of the scientist in the laboratory or library that give birth to new ideas in science.

There will be no exciting breakthroughs in the frontiers of science—but through research. To government and industry, research has become a mark of growth and quality.

As Director of the Agency charged to insure that advanced research

"firsts" are made available to our national security programs, I am deeply gratified by the creation of this CBS Laboratories Center and the many others like it throughout the land. For just as this center will do the work of industry, so will it do the work of Washington. There are so many things research can tell us; things we don't understand and, significantly, things we don't even know about.

This latter fact has been brought poignantly to our attention by the Explorer satellites. Explorers I and III carried cosmic ray counters which were totally and unexpectedly flooded by radiation particles in outer space. Reacting to this knowledge, we launched Explorer IV, carrying radiation counters deemed capable of measuring the radiation intensity. Again we were surprised as the ingenious counters in this last American satellite are nearly jammed by bombarding particles at apogee, about 1400 miles above the equator. We have gone into space seeking answers and have found not only answers but also a new and serious question which in turn must be solved.

Thus, in overcoming gravity, we have encountered radiation. Our objective now becomes one of charting radiation in space so that we can avoid it if possible. If not, then we must develop efficient means of shielding so that man can safely pass this barrier. And do you know, that from our research to develop protection from radiation in space, we may find means to protect our earthbound population from the radiation effects of a nuclear attack. This is the glory of research; it leads us in so many directions.

*The above was an address presented at the dedication of CBS Laboratories Research Center in Stamford, Conn.*

From the past we know that the defense research of CBS Laboratories and other electronics industries during World War II has led to the color television and computers of today. The creation of the atomic bomb brought about the harnessing of nuclear energy for public and industrial power.

As the United States government continues to invest in the future through research, we can expect similar by-products which lead to a healthy economy and nation. From studies connected with placing a man in space, techniques may be developed which will prove revolutionary to our hospitals. Learning how to transmit blood pressure, pulse, and respiration counts from space to earth may provide technology necessary for central hospital control rooms which can keep an alert eye on all patients at all times.

Through our future work with communications satellites, we may lay the groundwork for world-wide television networks (maybe even in color) which can bring the peoples of the world closer together. Through weather satellites we may predict and perhaps influence world weather patterns.

Our research horizons are unlimited. A word of caution, however,—we can reach out into space for our answers, *only so long as we are free*, and what we do in space is going to have a lot to do with our freedom. Now we must look at the other side of the space coin and I would be remiss in not turning it over here today. Yes, we must go to space, not just for scientific knowledge or desire to explore the unknown, but in the interest of our national security and protection of our way of life.

In consideration of disorder here  
(Continued on page 35)

## PART ONE

# A NEW APPROACH TO ELECTRONIC TRAINING

WITH THE EXCEPTION of those relatively few dedicated individuals called educators, training is a subject deemed dry and dusty by most people, but a necessary step toward acquiring a passport to a job. Our young people are happy to leave school and graduate with the mistaken impression that their education has been completed. In too many institutions, we have made the educational experience as easy, interesting and amusing as possible to the neglect of the basic reasons for the acquisition and retention of knowledge. We commonly refer to the better brains in our midst as "eggheads." But, proper educational training—be it scientific, technical or managerial to meet the challenge of the nuclear age—is a subject which should concern all Americans directly, especially those who are charged with preparing for the defense of our country.

The theme of this article is military training, particularly as it applies to the Air Force and specifically as it applies to the field of electronics, a science which is becoming progressively more important as time goes on.

In presenting this subject, some of the faults of our present military training program at the unit level will be pointed out, as well as an example of how one unit established a proven method of training to overcome them. It is hoped that the knowledge gained through this approach will contribute to a better preparation of the individuals within the Air Force.

There is a difference in the training difficulties faced by the military, that compound the problem of providing required technical training, as compared with those in civilian educational institutions. In a civilian institution, an instructor is generally dealing with people of the same, or

similar, previous training experiences or who have passed entrance examinations which indicate that their knowledge is up to par. In military schools, normally, the only common denominator is rank. Individuals come from all walks of life with various levels of educational experience and varied practical backgrounds.

There are times when an instructor in a military school "talks down" to a major portion of his students since he is confronted with the position of hammering home knowledge in order to guarantee that a fixed percentage of his class graduates. This is unfortunate and the results are obvious. Half the class is bored because they are assimilating knowledge faster than it is presented by the instructor, or are being led again over old familiar paths. A smaller percentage of the class is lost because it is getting new information faster than it is able to accept. A lucky few are going right along with the instruction given. Another problem is the fact that in airmen entry courses, few of the students have been properly motivated with a desire to learn the particular skill which is being taught.

They are, as often as not, assigned to a school because Air Force-wide vacancies, individual scores on aptitude tests and the opening date of a particular course all happen to coincide. We must remember that aptitude does not necessarily create desire. Many a potential "egghead" has ended up selling eggs.

The Air Force training program includes a complex multitude of on-and-off-the-job courses designed to provide technical instruction for all required operating and technical skills. The formal and specialized training courses offered by schools of the Air Training Command are good, but the educators in that command are faced

with many problems in addition to the problems previously mentioned. First of all, they are up against time. A course runs for a set number of weeks and the instructors, with proper background in educational methods and technical skills, are always in short supply as is also the case in civilian education. Technological progress is such that new equipment is often operationally available in the field long before the necessary changes are reflected in school training programs. The end result is that individuals trained in certain types of equipment in schools are assigned to field units employing equipment and devices which are strange to them. This requires additional training away from regular duty. It has also been found that in smaller units a man fresh from school may be the only man assigned in his career field with no "old head" to train him.

At the unit level, graduates of Training Command basic electronics courses have usually demonstrated that they have the ability to perform the operating functions expected of them on the equipment they have been taught to use in school. However, when given on-the-job training on new equipments or in repair of equipments on which they were trained, they have demonstrated a lack of knowledge of the fundamentals of electronics.

A recent study by the Air Proving Ground Command of a number of technical school graduates, of a particular electronics course, revealed this situation. Graduates lacked knowledge of the fundamentals of electronic theory: They knew what the meter was supposed to read but not why; they knew line-up procedures, but not why a certain sequence of adjustments had to be adhered to; they were able to replace

by Col. B. H. Wells, USAF | Chief | Communications Branch | United States Forces | Japan

defective components, but they were unable to go through the processes necessary to determine specifically what was wrong with the equipment.

### *Is Knowledge Important?*

At this point, you may well ask if this knowledge is really important. For years, telephone companies have used installers and central office repairmen who are trained to perform specific operations on specific equipments, in certain sequence, without knowing why. Replacement of components is their answer to equipment repair. This method may be all right if you want to limit a man to the installer-repairman level. But, if we are training a man toward a career, preparing him for advancement in a highly technical field, preparing him to instruct others and if we want an individual who, as he advances, will acquire knowledge of a complex assortment of related equipments, we cannot in fairness to the individual or to the Air Force neglect teaching him the fundamentals. He must know why the meter reads a certain value and further, how the meter works. Neglect of fundamental training in electronics means the watering down of skills within the Air Force. After all, the Air Force mission is to provide the nation with a highly competent combat-ready force in being and, secondly, with a nucleus of highly trained specialists which can be expanded as the occasion demands.

We must have the man who can rebuild an item of familiar equipment from a box of spare parts, who can rapidly understand the principles of operation of new or foreign equipments, who can look at a blueprint and understand the constantly changing state of the art and apply these changes to his own environment, when practical. If we don't have such a man, at least let us be honest. Do not call these people mechanics or repairmen when they are merely equipment attendants, meter readers or knob twisters.

Recognizing these gaps in fundamental training and firmly believing that a well-grounded knowledge of the fundamentals of electronics should have first priority in training airmen for the electronics field, the 4418th (later redesignated the 12th) Communication Group of TAC's 18th Air Force (now the 12th Air Force), after many weeks of prior planning and preparation, started a new unit school on 17 January 1955. This school was organized to give airmen assigned to an electronics career field a knowledge of the fundamentals

through a training program designed to obtain maximum utilization of their resources and at the same time aid them in seeking out suitable career objectives commensurate with their potential ability. The basic idea was to allow each individual to progress through a course of learning as rapidly as his ability would allow. The above-average airman and the faster-learning airman would not be held back by the slow learner nor would the slow learner become frustrated by a faster-moving class.

### *Factors Considered*

We made the basic decision at the start of this school that the responsibility for training airmen on individual types of equipment would be a squadron function. Also, the responsibility for operation and for training cannot be divorced without lowering performance. The group school would confine itself to the teaching of fundamentals which might go far beyond basic knowledge necessary to repair organic equipment of a particular squadron. Thus, we would be aiding the squadrons in their training programs because we would be providing trainees who had acquired the same level of background information.

In compiling the course, other factors were taken into consideration. First, we listed all of the various types of skills within a communications group in which we wanted to provide training. These included linemen, telephone installers, cable splicers, switchboard mechanics, teletype mechanics, electricians, powermen, cryptographic repairmen, carrier mechanics, radio mechanics and others. Each man is important in his own assigned career field and each career field requires more or less training than the next. The lineman, for instance, does not need nearly as much basic knowledge of electronics required by a radio mechanic. Second, our training people and the most proficient airmen from all of the squadrons got together and drew up the knowledge requirements of the various types of jobs—not just the knowledge required in the basic job but the foundation required in order to build toward the highest level within a particular career field.

To give an example of a simple field, as far as a knowledge of electronic fundamentals is concerned, consider again the telephone lineman: What does this man have to know about theory? Well, he must know the difference between conductors and nonconductors, or insulators. He

must know a bit about resistance and impedance. He must know about inductance, as encountered in transpositions and repeating coils. He must know the difference between grounds, shorts and crosses and he should have the ability to make tests to determine and locate simple circuit troubles. You can add a few musts to this collection. On the other hand, he does not have to understand vacuum tube theory, antenna radiation patterns and a multitude of information that a radio mechanic must know. Considering this, a "ladder-type" training course was instituted which permits a student to enter at the bottom step, or fundamental stage, and to progress through the course, a step at a time, until he has reached and completed the most advanced stage within his capacity.

### *Training Course Pattern*

We carried this pattern through all of the electronic skills found in a communications group and paired the career fields which require a common basic knowledge of fundamentals. (I want to emphasize at this point that this type of school is only practical at group level and above because of the diversified number of skills available and the size of the potential student body.) We then devised a small course of instruction which would provide a lineman with a basic knowledge of theory and called it grade 1.

The course was further subdivided into numbered phases, usually 3 to 8. A phase consisted of the material which we believed a normal individual with two years of high school could accomplish in one week. Our next course was called grade 2 and it consisted of the material which a telephone installer or cable splicer had to know in addition to what he had already learned in grade 1. Grade 2 was likewise divided into phases. The final school structure eventually looked like this: Grade 1—Lineman; Grade 2—Telephone Installers—Cable Splicers; Grade 3—Switchboard Mechanics—Teletype & Crypto Mechanics—Electricians; Grade 4—Carrier Mechanics; Grade 5—Radio Mechanics; Grade 6—Radar Mechanics.

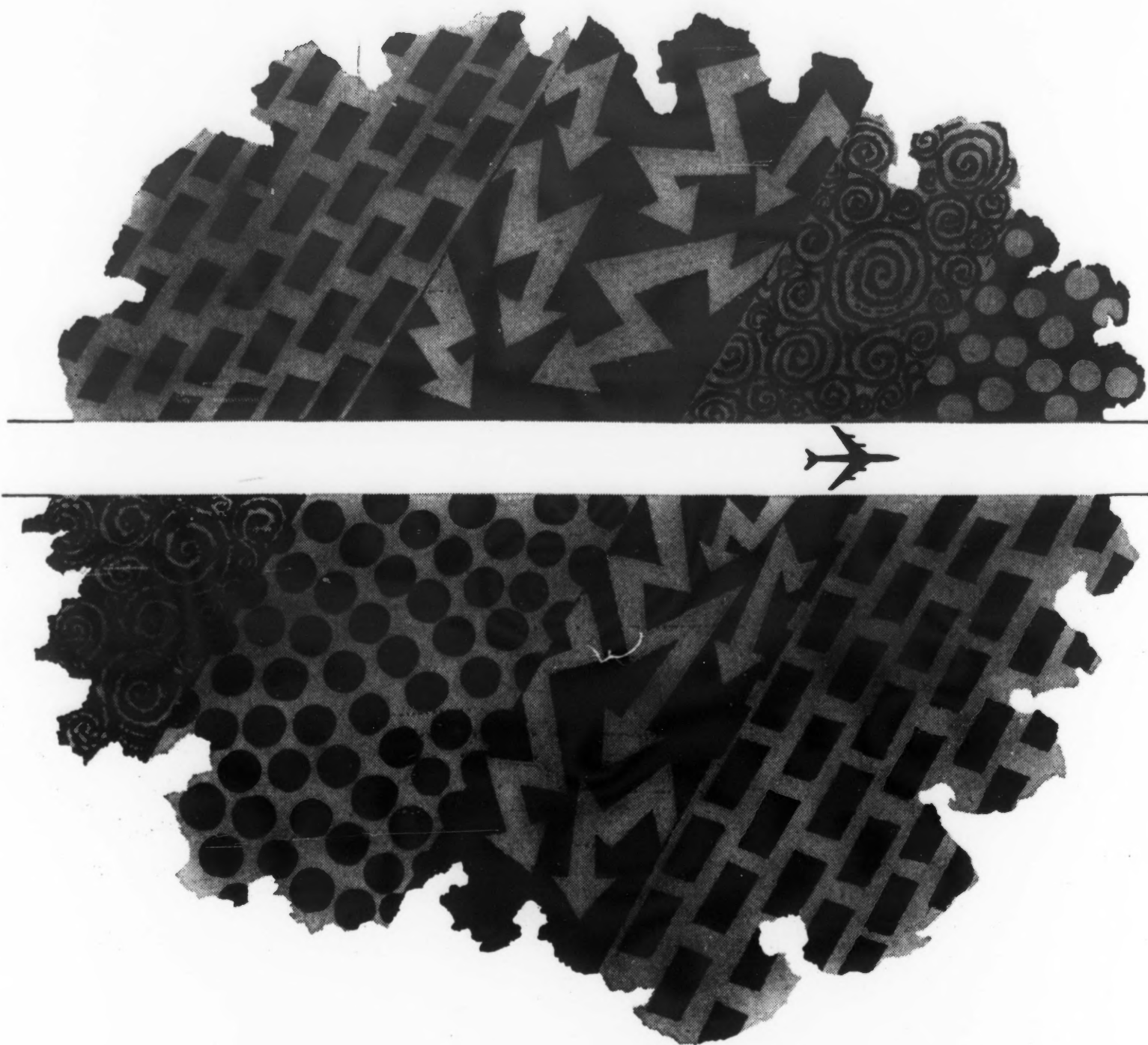
The grades and phases were arranged so that all airmen, from basics with directed duty assignments, to sergeants with seven-level (highest) skills, could progress along a single line of learning from fundamentals to advanced electronics. Each succeeding grade requires more knowledge of electronic theory than the one

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preceding it and each grade is related to a particular job or jobs.

We worked up a progressive laboratory program so that each student had some lab work, in each phase of the course, that was directly related to his study material. At first, the experiments were extremely simple such as hooking two dry cell batteries in series with a bell and a push button so that if the button were pushed the bell would ring. These experiments get progressively more difficult until the student would be winding transformers and constructing radio transmitters.

A progressive educational system similar to a correspondence course with lesson plans was prepared for each of the phases. The rate at which the material was presented was entirely dependent upon the student. A class instructor was available to answer questions and discuss points of controversy. Thus, in effect, each trainee had a tutor and each trainee determined his own rate of progress throughout the course. Training films were available to assist in presenting some of the material that was difficult to portray otherwise. Each and every student question had to be answered to the satisfaction of the student even if it had to be taken to one of the technical representatives.

### Testing

Examination questions were prepared on the information presented and questions were phrased in as many different ways as possible. These questions were grouped according to content. A phase examination might consist of three questions from one group, four questions from another group, three questions from a third group and two from a fourth, based upon the relative importance of the particular facts being covered in the grouped question package. This prevented duplication of examinations and the normal passing of information among students as to content of examinations. If a man did not make 90%, his exam paper was reviewed by his instructor to ascertain if he should be passed to a higher phase or grade. Errors in computation were forgiven but a lack of knowledge was not condoned and the failure was required to take his phase material over again. Two successive failures were cause for an interview with a board headed by the training officer of a technical representative to determine if the individual had reached his saturation or "phase-out" point. The standards were very high.

One individual did nothing but

give and supervise examinations. Another supervised all laboratory activity and the issuing of all laboratory materials. Completion of a laboratory experiment required the laboratory supervisors signature on a test request slip hand carried by the student to the examination supervisor. This type of control assured that testing and laboratory work were coordinated and standardized.

Another large task was the preparation of a comprehensive entrance examination to be administered to individuals with previous electronic training to ascertain what grade and phase they would enter. Entry level was determined, not by score on the examination, but by a review of the content of the student's answers to determine the "cut-off" point as far as a knowledge of electronic fundamentals was concerned. A student could possibly have a comparatively high score and yet reveal a complete lack of knowledge of vacuum tube operation. This individual, obviously, would be entered in the initial phase of instruction which teaches vacuum tube operation.

A student could fail to complete the course for one of two reasons. He had either reached the maximum level of his understanding, or saturation point, or he did not desire to acquire further knowledge. We attempted to solve this second problem with proper motivation. If the student did not respond to the "sales talk" we treated him exactly as another student who was incapable of understanding. An electronic mechanic is a very responsible individual and we do not want people in these career fields who do not recognize the need to know their jobs. Reclassification action was taken if the student did not reach the level of understanding required in his job assignment. For example, an airman "phased-out" of the course at the end of grade 2 because he lacked basic knowledge required for future progress in his field, but possessing basic knowledge required for a telephone installer, cable splicer or lineman, he should be reassigned to a field of endeavor in which he could perform adequately and progress normally. At times, complaints were received that airmen graduates of technical schools were being sent to a basic course. If these men really "knew their stuff" they had no trouble with the entrance examination and did not have to go to school. In any event, if their gaps in knowledge were few, their stay in school was short.

(To be continued in Dec. issue)

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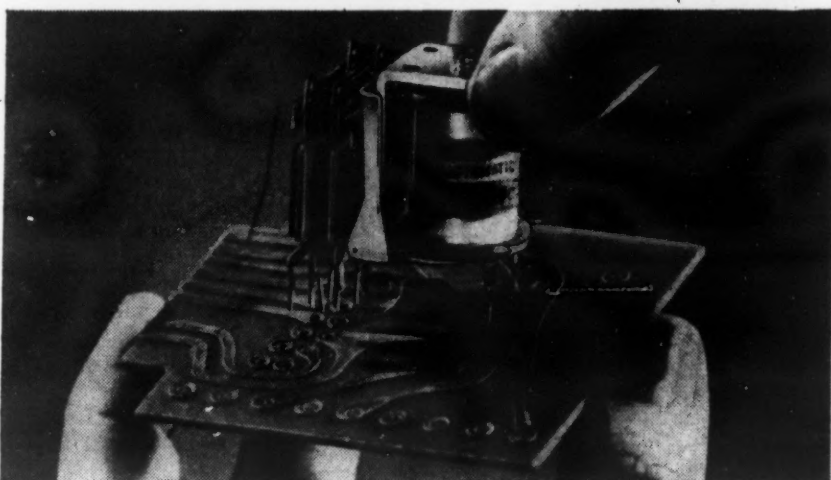
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# DEVELOPMENT TIME

*and its  
relationship  
to the  
over-all  
research  
and  
development  
schedule*

IT IS NOT POSSIBLE to start off on a subject such as this without putting it into proper context.

The West today—the civilization out of which America was born and of which it has become the leader—is as challenged as was the great civilization of Rome immediately before its decline and fall. Our response to that challenge is feeble, contradictory and confused. One real reason is that we have not really analyzed the challenge. We think it sufficient to extol the virtues of liberty, the superiority of the American and western standard of living, to point out the vices and failures of the Communists, and to keep this country and the West in a strong military position. The challenge in many sectors has gone largely unheeded.

Until the Sputnik came, we did not understand the challenge completely. Let us look at the achievements which are formidable:

- The Soviet Union in forty years, starting as a primitive, largely agricultural illiterate nation, has become the second industrial state of the world. She has been ravaged by war and revolution in this time. Her rate of industrial expansion exceeded our own and she had no investment of foreign finance from more advanced nations.
- She is equal and perhaps superior in military power and modern weapons to the West.
- She has produced a very large intellectual élite in all fields except the humanities and has seemingly inexhaustible reserve of scientists, engineers and technicians; quite as important are her enormous numbers of linguists who, among them, command the languages of the world.
- Her people, as a whole, are imbued with a fierce patriotism and sense of mission that despite their sufferings, make them convinced that Russia represents the wave of the future.
- In the past years, her entrance into Africa and Asia by means of foreign aid and investment at a rate exceeding our own and her establishment of conditions which appear to the minds of these people more favorable than ours pose a terrific challenge to the West.

- The Communists and their satellites proceed with a higher degree of integration than does the West.

These achievements cannot be ignored nor will they go away. What are we, as free men and women, prepared to do and to sacrifice to meet the challenge these achievements present? There is not unlimited time!

What is our rebuttal to this? In order to get a feel for the problem we have to define just what national strategy actually is. It is the use by a country of the economic, political, psychological and military forces in peace, as well as war, in order to accomplish the national objectives. Please note the military forces are only a part of this complex problem that faces us. So you quickly see that mere reorganization of the Department of Defense is not going to bring everything into order so that all will be right with our world. We have to have a clearly spelled out national policy identifying global interests of vital national concern for which we are prepared to wage any type of war against the Sino-Soviet coalition, with or without allies and without waiting for the United Nations to determine—by whatever means—that the Sino-Soviets are guilty of “aggression.” It is from this starting point we can go on.

We are members of a free alliance and this alliance is held together by the seas that cover most of this earth. The ability to help our friends and to keep this alliance a going organization is of vital importance. This is where the Navy has a function to perform and a job to do—one that has become more complex than ever. War today covers a complete spectrum all the way from the micro-war to the all-out thermo-nuclear exchange. We in the Navy have no ambition or desire to say we and we alone are the organization necessary to win this struggle. We do say, however, that if we do not perform our missions, we cannot win in this battle to death with the dictatorship of the proletariat. When one speaks of the sea he means above, below and on the sea.

This is a long way around to approach the subject of development time; however, it was necessary in order to put it in its proper per-

the Navy

## Radar Research at Westinghouse

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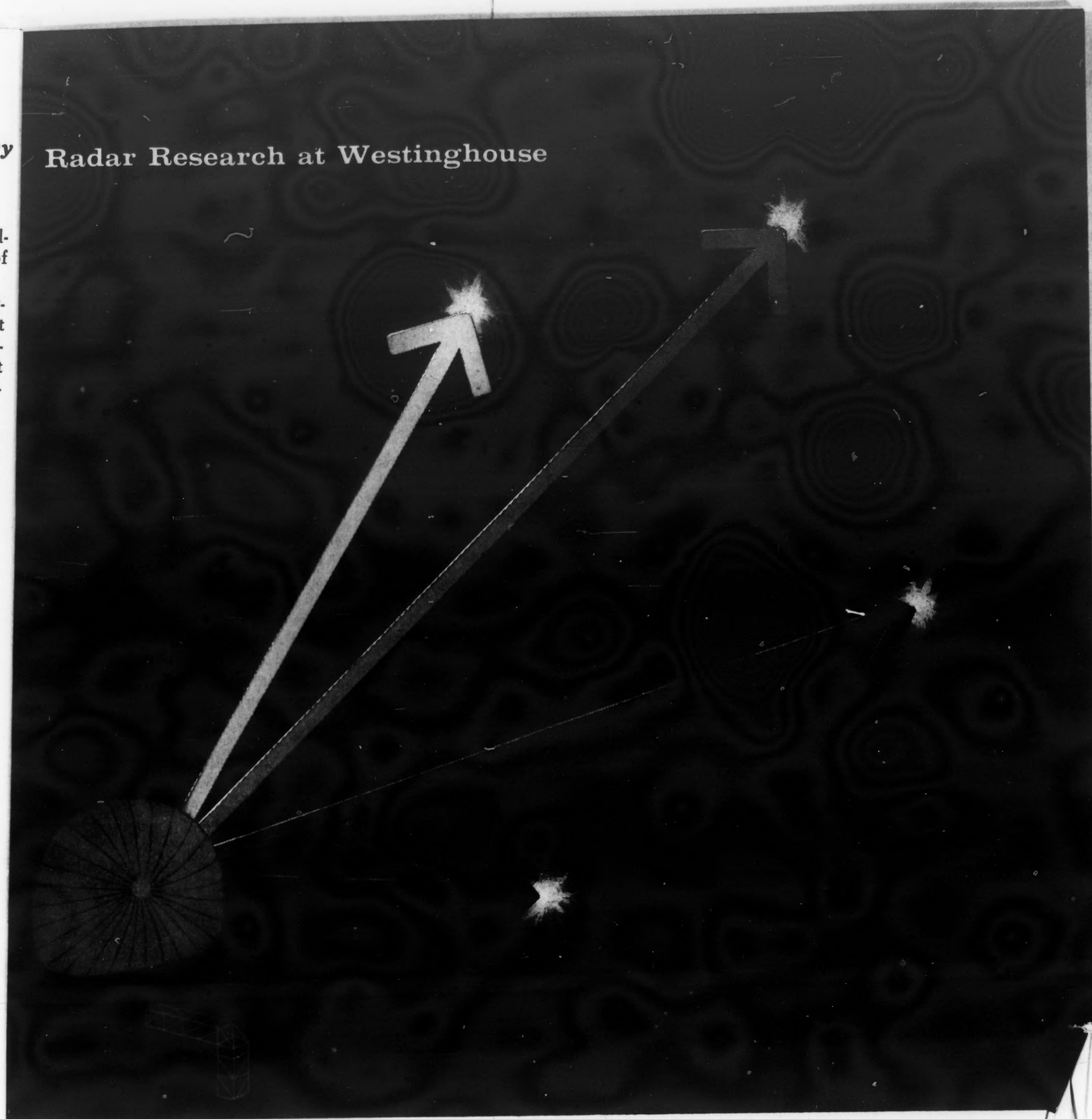
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spective. It is necessary to organize a research and development program around definite long-range objectives.

In other words, where are we going to meet this threat of the various types of conflict we have to face? We naturally cannot have everything we want or even think is necessary, so we must have a selective process. This applies to all systems.

This selective system plays a terrific part in the development time required. Anyone can make an operational requirement but if it does not make sense in the state of the art or where you reasonably believe it will be in the time in question, you pay a penalty of time. As an example, take the man who decides on a new airplane. If he calls for a Mach-5 airplane rather than a Mach-2, one can readily see he controls the development time to a considerable extent. By this very choice he largely determines the development time.

On the other side of the scale, a very little improvement in a system is called for so that while the development time is short, even if it does work, you have not got much for the time and effort expended. So one has to ask some very penetrating questions on the whole subject in order to really have a reasonable plan for a program. Such questions as the following must be asked and answered:

- Are the essential weapons on hand or in the process of development?
- Are we contemplating or prosecuting more ways of meeting a given situation than are necessary?
- Are the new weapon systems being required in a reasonable time scale within the known state of the scientific and technical arts?
- Are the gains in performance or capability sufficiently great to warrant adding a new system or replacing an old one?
- Can the existing system be modernized to produce an equivalent gain in performance or capability at less cost than a new one?
- Are the requirements unnecessarily complex so that we have an expensive system as a result?
- What is the threat for the task you are trying to meet in the time period you have to develop your system?
- There are many more questions and it must be noted that while the best technical answer might not always be the best policy, those who

make the policy must know the best technical answer. A look at our strategic bombardment missile program will quickly show that all these questions were not answered—in some cases not even asked. The development process can certainly be shortened by critical planning and by work in the selective process prior to the decision to go ahead. The shotgun may be good against birds, but this approach to the complex weapons systems of today is neither efficient nor will it give us what we need in the time period we need it.

Let's look at the situation that faces the Navy in relation to the above challenge and problems. The greatest threat to the free alliance today is the submarine and missile combination. Our success with the Polaris Program shows us clearly that this weapon system answers the requirements most necessary in a deterrent force. It has flexibility. It is a secure system and it is not dependent on foreign bases. However, we in the Navy would be the first ones to say that it is just a part of the over-all deterrent position that the United States must possess. We need flexibility in this portion of our answer to the spectrum of war. We can't afford to go down just one street in our ability to retaliate against or deter the Russians.

The Russian missile launchings pose a tremendous threat to the United States and its allies. So you can see the anti-submarine problem is high on the list. This problem is a very difficult one and involves under the sea, the surface of the sea and the air above the sea. No quick invention or breakthrough is going to solve this problem. The oceans of the world are large and it will always be a tedious, around-the-clock effort on our part to solve this problem.

When you look at the various situations that have faced us since World War II, you come to the much maligned and little understood aircraft carrier. This weapon system is one of our optimum systems for projecting our power across the sea in situations not only where we might be required to fight, but in the cold war. It is always hard for me to understand why people get so upset about the size of our aircraft carriers. The laws of physics are no respecters of the sea or the land. In order to operate modern aircraft aboard our ships, it is necessary to have 750 feet of landing space. This is the governing dimension for the size of our ship.

I call to your attention the fact that

the Russian Bloc is equipped with modern weapons. If our aircraft are to control the air over the sea or land in these situations they must be modern. As long as the manned airplane is with us, the aircraft carrier will be here. Fifteen times since the Korean War ended the United States has been required to either show force or use force in situations across the sea. The only way this has been possible has been through the Navy and specifically, the aircraft carrier. The decision on the sea, as on the land, still rests with the decision in the air.

Our philosophy in these situations is that we have the capability of the precise delivery of weapons on military objectives—and I mean precise. We can ill afford to incinerate our friends or completely devastate the country involved. This situation will always involve a third country. It is necessary that we be in a position to move rapidly and decisively in this area or we will gradually be nibbled to death by the Communists. The perfect example of what I am talking about is what occurred from 1945 to 1950. Many people claim that we saved western Europe because we had a monopoly on the atomic bomb. Look very closely at events, however, and see actually what happened. While we were thinking this, we lost a continent—600 million people went under the hammer and sickle of Communism. This certainly should show us that our reasoning was fallacious. All one had to do was to look at Mr. Lenin's statement: "The closest way to Paris is through Peking." They took it!

A review of events since 1945 and various situations that have faced our Armed Forces gives you some idea of the threat and the problems that face us in the future. Our weapon systems must be such that they meet the various problems across the entire spectrum of war as it now exists and will exist in the future.

This requires great selectivity in choosing these systems and, of necessity, means short development time to bring the systems into being. We cannot afford 7 years as has occurred in the past. If we answer the questions that I have posed, we should be able to make good decisions and to cut down this development time. I would be naive to think that this is going to happen overnight.

However, let me assure you that we in the Navy in the research and development business are going to do our best to really make it occur as soon as possible.

**T**HE EFFECTS of nuclear radiation on electronic devices have been studied for some time by The Hallicrafters Co., chiefly in connection with the problems of developing military electronics equipment for use in nuclear environments. We have prepared what is probably the most extensive bibliography extant (containing some 800 items) on the subject of radiation damage to electronic components.

As everyone knows, electronics is a complicated subject. Just how complicated it can be may be visualized by considering that the number of ways in which 2 five-element vacuum tubes can be connected in simple series connection is  $10!$  or 3,628,800. If you made a new circuit diagram once every minute without stopping, it would take you seven years to draw them all. If we add just one more pentode, the number of simple circuit connections rises to  $15!$  or 1,307,674,368,000. We have not had time to figure out how long it would take to draw up all the circuits at the rate of one per minute.

Fortunately, the complexity of the subject can be conveniently reduced to manageable proportions by considering all electronic circuits to fall within a few simple classes—for example, detectors, amplifiers and oscillators. These circuits, moreover, are composed of a number of simple and understandable components—conductors, insulators, resistors, capacitors, vacuum tubes and semiconductors. We will examine the effect of nuclear radiation on electronic circuits in terms of the effect of the radiation on these components.

The properties of materials, particularly electrical properties, depend on two factors—the kind of material (its chemical constituents) and its microscope structure (whether it has a crystalline, fibrous or amorphous structure). It follows that anything which changes the chemical composition or crystalline structure of a material usually changes its physical properties also.

The principal types of nuclear radiations which affect electronic circuit materials are neutrons and gamma radiation.

Slow neutrons may be absorbed by the nucleus of an atom. This process usually results in the formation of a new kind of atom having different chemical as well as physical properties. The new atom is usually radioactive which makes anything made of it less likely to perform its normal electrical function and, in addition, makes it dangerous to handle because of the radioactive disintegration products it emits.

Fast neutrons may cause dislocation of atoms from their normal crystal lattice position, or position in the molecule, thus usually altering the properties of the material which depend on its crystalline or molecular structure. Not all such changes are harmful. Some, in fact, may be beneficial. For example, many plastics consist of long chains of atoms. When some of these atoms are displaced from their normal positions in the chain, the material shows a marked increase in mechanical strength, a result of the process called cross-linkage. However, since atoms are composed of particles of positive and negative electricity, dislocations such as these sometimes result in separation of the positive and negative components. In the case of polyethylene, this separation results in the formation of high voltages between a wire conductor and its shield when polyethylene is used as wire insulation leading to electrical breakdown of the cable.

Gamma radiation principally causes ionization (or separation of the positive and negative charges in a material) thus bringing about changes in molecular struc-

## radiation effects in electronic devices

by **Henry H. Hausner**  
**Nuclear Engineering  
Consultant**

**The Hallicrafters Co.**

and

**C. F. Johnson**  
**Research Engineer  
Systems Engineering  
Section**

**The Hallicrafters Co.**

ture, particularly in complex molecules. Very energetic gamma radiation can affect the nucleus of atoms quite as well as neutrons can, thus inducing radioactivity. Changes in electron emission and production as the result of gamma irradiation, particularly in photoelectric devices, are marked. Solid-state devices such as transistors and crystal rectifiers are usually ruined since their normal operation is the result of a very particular lattice structure.

The glass envelope of vacuum tubes is discolored, leading to reduction in efficiency of photo and viewing tubes. In addition, the glass often cracks, resulting in failure of the tube as the result of loss of the vacuum. Curiously, the glass, especially developed for long life seals under normal operating conditions, is especially susceptible to failure under irradiation, while ordinary glasses often survive irradiation undamaged.

In determining safe radiation levels for equipment, it should be emphasized that the information available is very meager and a great deal more work must be done. In particular, more tests are needed to determine the equipment radiation tolerance during operation. Most of the data has been taken on a "before and after" basis.

When we observe the variation in dielectric constant, power factor and dielectric loss factor for commonly-used liquid dielectrics as the result of high level gamma irradiation, we see the significance in this data. Any transformer or capacitor using these dielectrics would electrically behave like a sieve since a large amount of power would leak to ground, especially in the case of transformer oil.

There is a change in capacitance and dissipation factor for some paper capacitors. The capacitance remains relatively unaffected but an increase in dissipation factor occurs, which reduces the effectiveness of the capacitor since the dissipation factor is the ratio of the energy dissipated to the energy stored. A perfect capacitor would, of course, dissipate none of the energy applied to it. In practice, dissipation always occurs as the result of the fact that every dielectric is a conductor to some extent. In addition, many dielectrics are polarized by the electric field and depolarize slowly after removal of the exciting field.

The significance of the increase in dissipation and dielectric loss factor is shown when, in brief, a change in phase angle between the current and voltage from its normal value of  $90^\circ$  occurs with increasing dissipation factor. By adding a fictitious resistor in series with the capacitor to represent conductance and polarization loss in the dielectric, we are able to calculate the change in phase angle.

When we observe the effect of neutron radiation on three selected germanium diodes, we note that the forward current is reduced and the back current increased so that, ultimately, the rectifying action is destroyed.

Let us consider a phenomenon of interest which gives a clue as to a means of both understanding and dealing with radiation-induced changes in structure. First, we note the normal variation of dielectric constant of barium titanate with temperature and its subsequent lack of variation after irradiation. Barium titanate is a very valuable dielectric for the capacitor manufacturer because its unusually high dielectric constant permits the building of more capacitance per unit volume of capacitor size. However, its undesirable non-linear variation in dielectric constant with temperature militates against its use in many applications. Despite the halving of the dielectric constant by irradiation, its value of about 250 is still 40 times higher than that of the usual high quality dielectric material. Secondly, we note the variation of resistivity with neutron irradiation of  $\text{Cu}_3\text{Au}$  alloy. This alloy, as is well known, exists in two states, ordered and disordered, depending on its temperature. The change of resistivity after irradiation of the alloy in the disordered state is negligible in comparison to that occurring after disruption of the ordered state by irradiation.

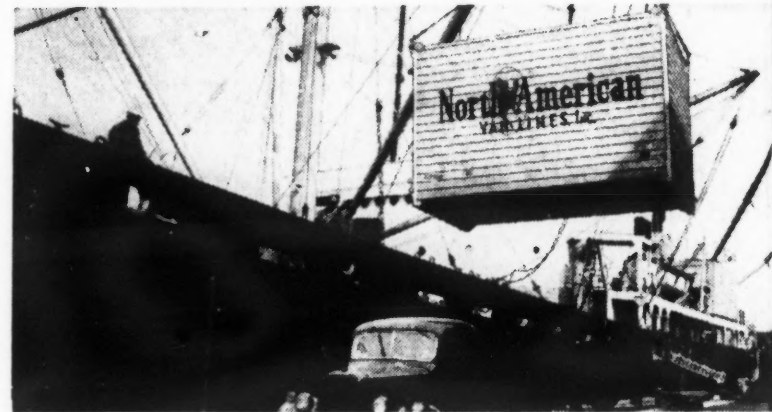
One general conclusion, which can be drawn from the foregoing, is that it may be possible to pre-treat material to enable it to withstand nuclear radiation. If means can be found to bring about in other ways the changes normally induced by radiation, then the effects of irradiation will be minimized.

The subject at present is still in its infancy and a great deal more work will have to be undertaken to acquire the data necessary to establish reliable practice in this field. In particular, the investigation of the behavior of electronic equipment during, rather than after, irradiation will be required. At present, this is not being done as extensively as needed because of the high cost of installing and operating facilities of the requisite capability. A reactor test facility capable of testing even the smaller size "black boxes" of the electronic industry would cost in the neighborhood of \$3 million to construct and a half a million a year to operate. At present, no such facility is available for the testing of complete circuits at high flux levels. The reactor facilities which are available were not designed so as to admit whole packages of equipment for test. Those which are available are capable of testing only small components and those facilities are in such demand that it is difficult to obtain time and space in them.

As was pointed out by Col. William Donics of the Communications and Electronics Division, ARDC, in a 1957 Chicago speech, the electronics industry must find a solution to the problem of developing electronic components capable of operating in a nuclear environment if we are to realize the fullest benefits of the nuclear age.

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#### Communications and the Commander

(Continued from page 14)

we must allocate to a user the proper communications facilities. Each individual and each unit must be served according to his or its requirements and no more. When a user requires a facility for his use alone, he must be given a "sole-user" facility. When he only requires a facility which can be shared with others, he is given a "common-user" circuit. There is no room for luxury in atomic warfare. Over-allocating is just as unpardonable as over-killing.

- **Resiliency:** The devastating firepower of the atomic battlefield will bring swift, severe damage to communications facilities. We must be certain that enemy action does not completely cripple communications. To guarantee this, we must have a system that has the ability "to bounce back." Any sudden interruption must evoke a speedy reaction to restore service and prevent loss of messages over the affected routes.

- **Reserve:** It is tactical doctrine to keep a portion of the maneuver elements and firepower in reserve. It is equally good communications doctrine to reserve some of the ability to communicate. The communications reserve, like the tactical, must be committed at the proper time, never too late and never too early. If it is committed early, a subsequent event may find the reserve depleted and communications inadequate at a crucial moment. If committed too late, necessary communications are wasted and some units have been deprived of an added communications ability.

- **Flexibility:** Flexibility implies an ability to change the communications system quickly and effectively to meet

new demands and new situations. We must be able to adapt the system to changes in the tactical plan and in the communications requirements. The system must be adaptable to all tactical operations: defense, attack, withdrawal, relief in place, vertical envelopments, river crossings, follow and support missions and all other tactical maneuvers.

- **Security:** No communications system is good if it provides the enemy with a knowledge of our intentions, plans, strengths, and weaknesses. It must embody proper and relatively fast encryption devices. All the elements of communications security must be provided wherever possible. Transmission and cryptographic security are not enough. The system must have provisions for a reasonable degree of physical security to minimize the danger of physical compromise, damage and destruction.

#### Conclusions

Atomic warfare has increased the degree of dependence upon communications for adequate control by the tactical commander of his maneuver elements. Reliable, swift and secure communications can be achieved through meticulous planning. The nine principles of communications—the principles of the alternate, mobility, cooperation, coverage, economy of facilities, resiliency, the reserve, flexibility and security—establish basic points which can be used as guides in the formulation of signal plans and communications systems. Similar to the principles of war, these principles will serve to increase the probability of success in providing the commander with a communications control over his units at all times, in all tactical situations, over a wide area, in a fast moving situation and in spite of severe damage by enemy atomic action.

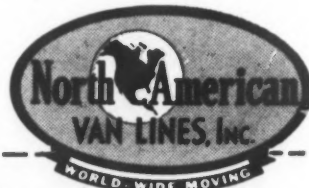
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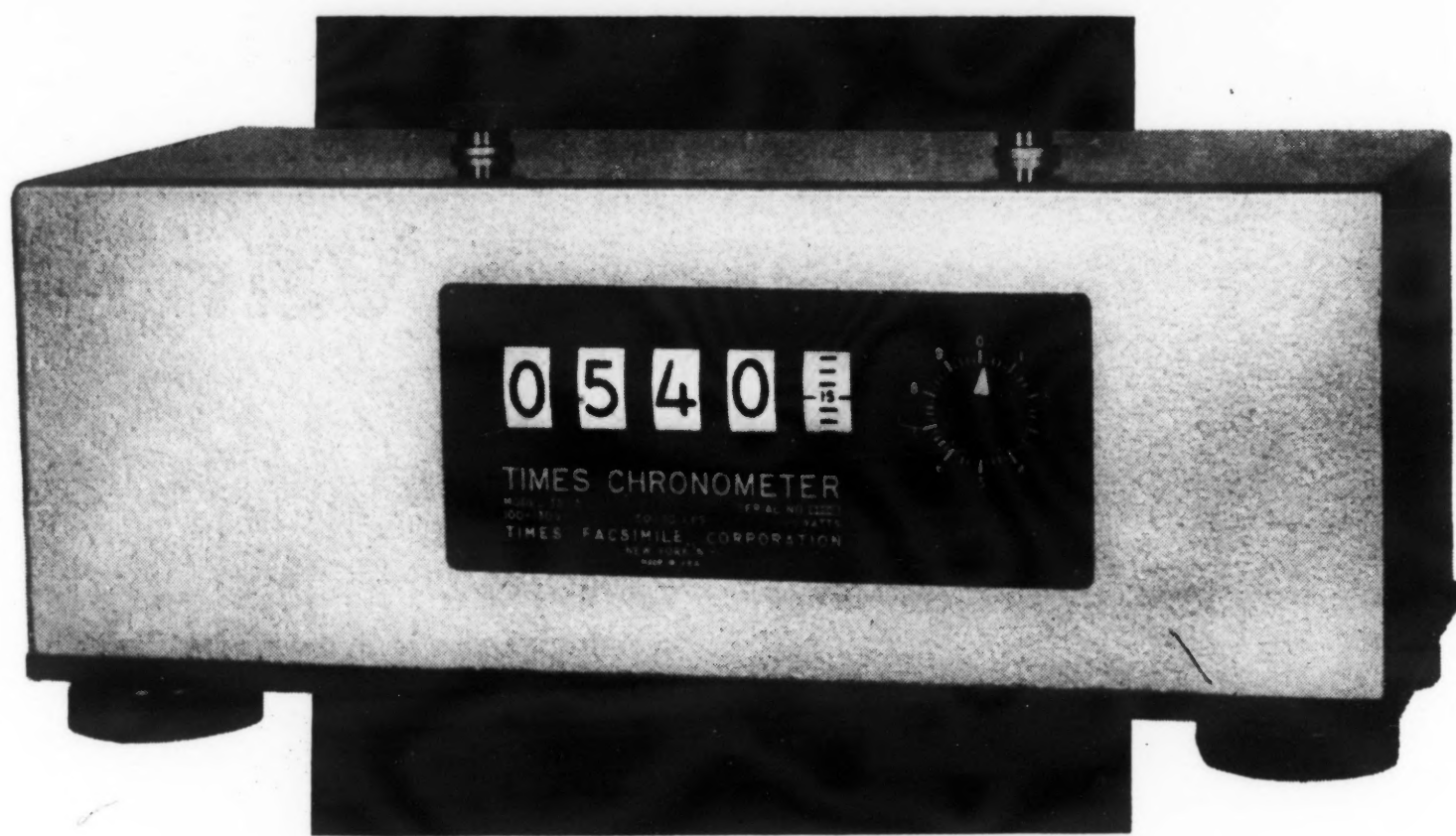
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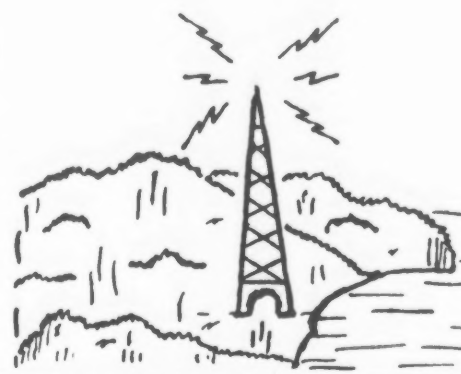
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# SIGNAL·GRAM

## — GOVERNMENT —

**ROCKET WITH 1.5 MILLION POUNDS OF THRUST** North American Aviation, Inc. has received a contract to develop a rocket under a high priority Army Program. An official of North American described the development within a year of a rocket with 1.5 million pounds of thrust as "conceivable" and this rocket could land a 2,000-pound payload on the moon. Existing components of Thor and Jupiter rockets which develop about 150,000 pounds of thrust, will be combined to develop the 1.5 million pound thrust rocket. Liquid fuels will probably be utilized.

**NASA PROJECTS** President Eisenhower has transferred the control of the Vanguard satellite program from the Defense Department's Naval Research Laboratory to the new civilian National Aeronautics and Space Administration—although the services still will perform the actual work. NASA will also supervise the military programs for 2 lunar probes assigned to the Air Force and 2 to the Army, 3 satellite projects assigned to the Army and the million-pound thrust rocket engine under development by the Rocketdyne division of North American Aviation, Inc.

**LUNAR POWER STATION** Westinghouse is seeking to sell the Department of Defense a plan for building a self-sufficient power station on the moon. This lightweight moon station would convert sunlight into electricity at a small cost on a so-called electron farm, using wire mesh spread out on the moon's surface parallel to giant sheets of chemically coated plastic. When the sun strikes the plastic, electrons are activated and collected by the mesh creating an electric voltage which exists as long as the sun shines on the surface. Dr. Castruccio, an authority in space guidance and communications problems, recently explained the construction and operation of the moon power station.

**NAVY SHIP PROPELLER BREAKTHROUGH** The Office of Naval Research has announced the development of a new-type ship propeller, described as "representing a significant scientific and engineering advance in modern ship propulsion unprecedented in the past thirty years of hydrodynamics accomplishments." The development of this new "super-cavitation" propeller has resulted from work done in the field of hydrofoils (a hydrofoil boat skims above the water on stilt-like legs attached to underwater or surface-piercing "skis.") Previously, "cavitation" (the formation of a vacuum around rapidly revolving propellers) has been an important physical barrier, having suppressed the speed of propellered-ships. The new breakthrough may provide the Navy with the world's fastest sub-chaser.

**CONTRACTS: ARMY:** Western Electric Co., continue rapid development of the Nike-Zeus anti-missile missile, \$135,000,000; The Ramo-Wooldridge Corp., automatic data processing system test facility, \$2,828,297; Hughes Aircraft Co., production of certain elements of "Missile Monitor" air defense systems for use by a field army, \$30,-689,713. **NAVY:** Aerojet-General Corp., build the hydrodynamic frame of a high speed torpedo and propulsion system, \$19,300,000; Tidewater Construction Corp.—Norfolk, Va., Peter Kiewit Sons—Omaha, Neb. and Patterson-Emerson-Comstock Inc.—Pittsburgh, Pa., construction of giant Naval Radio Research Station at Sugar Grove, W.Va., \$60,-000,000. **AIR FORCE:** Kollsman Instrument Co., MD-1 astro compass and components B-52, \$3,498,683; Vitro Engineering division of Vitro Corp. of America, maintenance and operation of SAGE units, \$2,627,332; Westinghouse Electric Corp., tactical radio communications equipment light enough to be airlifted by helicopter and capable of transmitting and receiving 48 voice conversations simultaneously, approx. \$1,000,000.

## — INDUSTRY —

**RCA PROFESSIONAL PLACEMENT OFFICE** Radio Corporation of America has opened a permanent professional placement office at 630 5th Avenue, New York 20, N. Y. The office will function on an interview-by-appointment basis, Mondays through Saturdays and is geared primarily for scientists and engineers of senior level. RCA is interested in engineers in the fields of high power transmitters, weapons systems, microwave, equipment design and development and solid state devices, as well as space age electronic applications.

NEW RAYTHEON DIVISION Raytheon Manufacturing Co., Waltham, Mass., has established Government Services division which will furnish field engineering, installation, operation, repair and overhaul, training and technical publications service to the firm's government customers. The new division also will offer customer training management and operation of government projects, shops or facilities in the customers' areas, in this country and abroad.

"FINANCIAL WORLD" WINNERS The Eighteenth Annual Survey of "FINANCIAL WORLD," national weekly business-finance magazine, rated the 1957 Annual Report in the Office Equipment Industry prepared by International Business Machines first place, and Electronic Associates, Inc. placed third. Approximately 5,000 reports originally were entered in the 1958 competition. The annual report of Sylvania Electric Products Inc. was judged as being the best in the radio-television industry category.

### — GENERAL —

INTERNATIONAL RADIO BAND AGENCY Dr. Hans K. Ziegler, U. S. delegate to the IGY assembly in Moscow, reported that Russia and the United States will cooperate in setting up an international control agency for the assignment of radio frequencies for space use. Dr. Ziegler, assistant director of research for the U. S. Army Signal Research and Development Laboratory at Ft. Monmouth, N. J., said he proposed the international control agency idea in a resolution before the assembly and it was unanimously accepted. Reaching an international agreement regarding the use of frequencies of radio operating from satellites and spaceships is essential in order to communicate data and messages without interference.

"HAM" RADIO NEWS An amateur radio operator held conversations on Sept. 13 with two other "ham" operators, 2,000 miles away, using a transistorized transmitter and receiver powered entirely by energy from the sun. Major Gilbert, K6LMW, Los Angeles engineer with Hoffman Labs. Div., made voice contact with Henry A. Kusek, W9KZX, Chicago and W. Leonard Gregory, Jr., W9RLY, Mt. Prospect, Ill. Gilbert's station was operating solely on power supplied by a bank of silicon solar cells similar to those used for the radio transmitter of VANGUARD. This is believed to be the first time in history that a radio transmitter on the 10-meter band has made a long-distance voice contact using solar energy as its sole source of power.

SYLVANIA FOOTBALL FACT BOOK A handbook of football facts and figures containing complete college and professional schedules for 1958 is now being made available by Sylvania Electric Products Inc. through radio and television service dealers. The 48-page booklet includes a section on official signals and penalties for college and pro football, and it lists records, scores and standings for 1957 together with predictions for the up-coming 1958 season.

TV OWNERSHIP STATISTICS The recently published 27th semiannual edition of "Television Factbook" indicated that more American homes have television sets than telephones or bathtubs. The publication reported that 42,400,000 U. S. homes have TV, while 39,000,000 homes have telephones and 41,500,000 have bathtubs.

#### CALENDAR OF EVENTS:

NOVEMBER 19-20: The Northeast Electronics Research and Engineering Meeting is to be held at Mechanics Hall, Boston, Mass. The meeting is sponsored jointly by the Boston Connecticut and Western Massachusetts sections of IRE.

NOVEMBER 28-DECEMBER 4: The Electronic Computer Exhibition and Business Computer Symposium is to be held at Olympia, London. This event, the first of its kind in Europe, has been organized by the Electronic Engineering Association and the Office Appliance and Business Equipment Trades Association.

DECEMBER 2-4: The 3rd EIA Conference on Reliable Electrical Connections is to be held in Dallas, Texas at the Statler-Hilton Hotel. The conference will be unique in that no papers will be read. There will be no exhibits and no formal lunches or dinners. The papers will be published in advance with only summaries to be presented at the conference by the authors. Thus, the maximum amount of time can be devoted to panel and floor discussions. An invitation to attend the conference may be obtained by sending your request on a postal card to Mr. George Roesch, General Chairman, 1068 South Clinton St., Syracuse 4, N. Y. All invited.

DECEMBER 3-5: The Second National Symposium on Global Communications (Globe Com II) will be held in St. Petersburg, Fla. at the Colonial Inn-Desert Ranch, being sponsored jointly by the IRE and AIEE. Sixty technical papers. Fifty exhibitors.

DECEMBER 3-5: The Eastern Joint Computer Conference is to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa. and will be sponsored by PGEC, AIEE, ACM. Exhibits, technical papers and sessions are to be presented.

**Research—A Mark of Growth & Quality**

(Continued from page 19)

on earth, we must be militarily vigilant in space, as we are in all other areas accessible to potential opponents. We must become as capable as any other nation to operate weapons systems in space with missions pertaining to space or the earth's surface. We must be able to conduct earth-to-orbit and orbit-to-orbit operations for defensive purposes and for insuring our access to space.

This is what puts the prime urgency into the space plans and programs of the United States and results in our national investment of millions of dollars for space research and its resulting technology. Born of this urgency is the intense work, resolution, and character which may have to be expended over our entire lifetimes and into generations beyond us. It will be that way until Communism as a way of life has faded from control over major nations on this earth. If we are to survive, we must go forward by giant steps on the long legs of advanced research.

There has been great concern throughout the Free World that space will not be a peaceful place. There has been no such concern evident in the Communist camp. Why? Because the Communist leaders know beyond a shadow of a doubt that the Free World longs with all of its collective hearts to keep free space free. They rely on this longing, they abet it with hollow pronouncements, while pursuing secure programs under strict military discipline. Can anyone doubt the grave military and political implications of a Soviet man circling the earth in a space vehicle beyond our power to counter? Does anyone doubt the military profit of a manned lunar base? I can assure you, there is no doubt in Moscow.

I like to think that recognition of these facts created the Advanced Research Projects Agency in the Department of Defense. And ARPA is taking broad and basic approaches to the national security objectives of this country, objectives which must be satisfied by advanced research.

We have many programs underway. In the field of ballistic missile defense, considerable research work must be done to enable us to meet the threat in all of its formidable variety. Conventional techniques may prove inadequate and a wholly new system required. To give us essential knowledge upon which to base future decisions, ARPA is conducting or sponsoring basic research in re-entry physics, very early warning, radar,

data processing, and other related areas. I should like to underline the key role of electronics research in the probable resolution of this priority problem.

As concerns military space technology, we have begun or are developing programs for military satellites, tracking, high thrust boosters, communications relay, and other exploratory research. We are also pursuing advanced research which can lead to the high performance solid propellants for future propulsion systems.

In certain fields of research, such as large engines and man-in-space, ARPA will conduct closely coordinated programs with the newly created National Aeronautics and Space Administration. Through this mechanism, space applications which promise benefits to national security, as well as to science, will not be lost to the defense of the United States and the Free World. For, while national security is becoming increasingly dependent upon scientific progress, the latter cannot be achieved without the environment provided by an excellent national security posture. The two are simply hand in glove.

The Congress of the United States, with full appreciation of the importance of this new era of science and technology, acted wisely and swiftly in constructing and passing the National Aeronautics and Space Act of 1958. However the Congress, also fully aware of the national security implications associated with the space age, further declared that activities *peculiar to, or primarily associated with, the development of weapons systems, military operations, or the defense of the United States, and including the research and development necessary to make effective provision for the defense of the United States, shall be the responsibility of, and shall be directed by the Department of Defense.*

Accordingly, we in ARPA are busily engaged in insuring that military applications in space are available to this country when we need them or better yet, before we need them.

We must look to a day of manned space vehicles. Therefore, ARPA is examining programs in the field of maneuverable satellites and of winged space vehicles. Furthermore, ARPA is looking for weapons systems that may be applied to one of our major military problems: limited war. We are looking into areas which may provide breakthroughs in non-lethal weapons. It may be that this new Research Center will help us find electronic means to win battles without bloodshed or harm to man.

What then is research to the American way of life? Well, it is the means by which all Americans take part in the human progress and national security which it fosters. Nevertheless, commitments for a long pull to a better future require national strength of character.

The exploratory adventures of Columbus have been compared to our endeavors of today. They have common characteristics—faith and courage. Our faith is in the cause of progress and democracy and our courage is to look into the future and invest in it through research. We must have confidence that our science can overcome radiation and other problems in outer space. We must have confidence in our way of life that will allow us to pursue our scientific and military programs on earth and in space with the dynamic quality of a nation seeking to express its integrity and its strength.

As a nation, we need not be ashamed to utilize our broad and proven military capability in space, no more than we need be ashamed of the defense research which has meant so much to the freedom and prosperity of our nation and its friends.

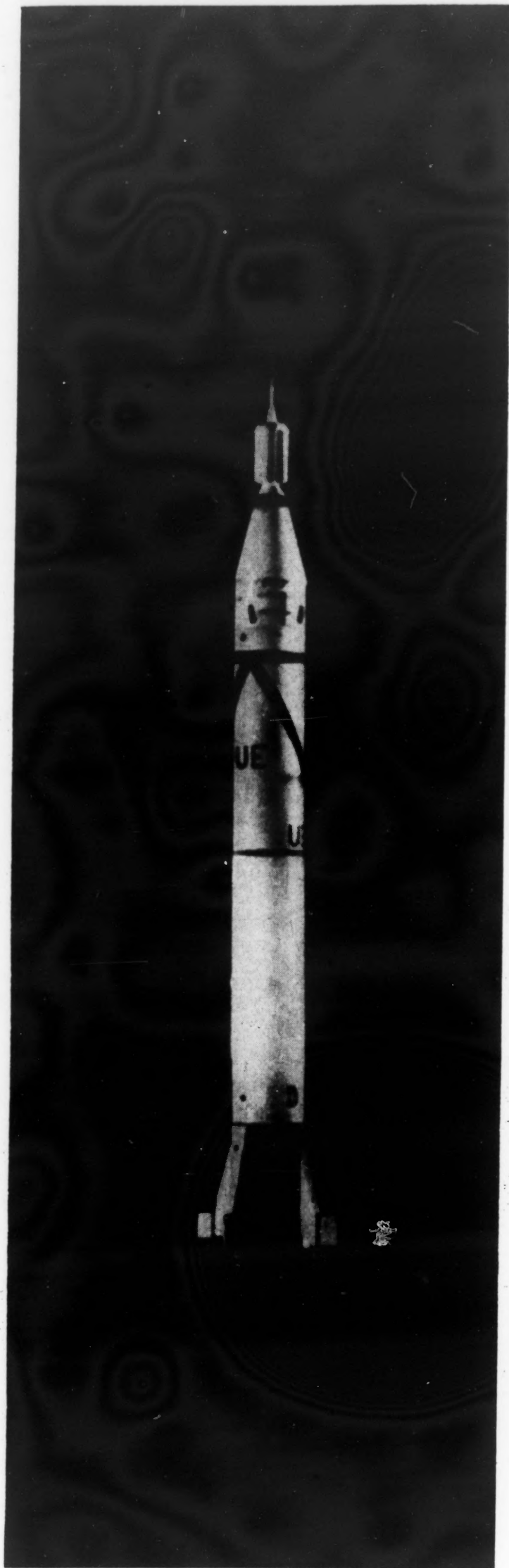
Let me emphasize that point. The United States, in recognition of the fact that its government responds to a moral and national, indeed even a world opinion, born of respect for the dignity and belief of the individual, need not regard its military activities in space in the same light as the leaders of the USSR must regard theirs. Those who govern by consent are not haunted by the fears of illegitimacy that plague the communist dictators of this world. As a nation, we must expect to use our entire assets in the great work ahead of us. Whether in science or in defense, we are under every obligation to the spirit of this nation to do all we can to make progress a hallmark of our national existence.

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# VISUAL MISSILE COMMUNICATIONS

by Col. Charles W. Gibbs  
Signal Officer  
US Army Air Defense Center  
Fort Bliss, Texas



THE AVERAGE person thinks of visual communications as being obsolete by modern standards and consists of such things as smoke signals, wig-wag flags and at night a flashing lamp.

This mental association of a communications network with an era is being knocked into a cocked hat by the surface-to-air missileman. He is using *visual* communications to fire and control missiles which travel at supersonic speeds!

It is a strange paradox that weapons as modern as the guided missile should go full cycle through all the communications means which we think of as modern, and return to visual which is the oldest form of communications. But scientific and military progress make strange bedfellows.

It is barely possible that we may gain a hint of the future of communications, if we track the history of what the modern day missileman has done to that science in the past few years, and how he arrived in the Penton Age with a super-modern weapon and the oldest form of communication inseparably wedded to its successful operation.

As seen through the eyes of a professional communicator, the surface-to-air missileman is basically an artilleryman—but a rather special breed of artilleryman because he has “flown in the face of convention” and has been eminently successful in scrapping some outmoded tradition. He has put together some rather ancient artillery techniques and made them work in the same harness with super-modern “electronic-brain” techniques. And as of this writing, he is rearranging his techniques to cope with enemy long-range missiles which he may be called upon to defend against in the future.

If the surface-to-air missileman has any one dominating characteristic which distinguishes him from others, it is his imaginative approach to his problems and his ability to adapt to rapidly changing conditions. Being highly imaginative he is quick to adopt any technique, piece of hardware or communications means which will improve his ability to perform his mission. He does not have to be sold on modernization, he is already sold on that and indoctrinated with the “imaginative approach” when he graduates from the U.S. Army Air Defense School.

During World War I when the airplane was introduced as a weapon, the Coast Artillery saw it as a bombing and reconnaissance threat to its fixed coastal batteries.

The early anti-aircraft artilleryman adapted some of the precision control equipment, communications and fire techniques which had been used with the coast defense guns. These formed the nucleus of the anti-aircraft weapons system of that day.

Radar was used extensively by anti-aircraft artillery even in its early days when the range of the radar was greater than the range of the weapons. And today with radar as an extension of his vision he scans the skies, tracks his missiles and targets and toils on the frontier of human knowledge and skill to improve the speed, accuracy and deadliness of his ever-increasing family of surface-to-air-weapons.

Since the targets he must engage and destroy are getting to be faster and faster, the missileman of today must reduce the reaction time of his weapons system in order to stay in the race against time.

Since the components he has put together to form the present-day weapons system operate at different speeds, information is exchanged between elements of the system by a variety of means. The mode of exchange is determined by the speed with which the components of the

system can utilize and react to information. For example, a man (which for purposes of this discussion is a component of the system—the most important and necessary component) can hear an alert over the telephone. He can relay this to a radar set by a push button or a switch. This exchange between men, and from man to radar is a relatively slow process. The speed of this exchange is governed by the speed of the man. He must hear the alert and react to it by activating the radar with a hand-operated push button. The radar in turn starts exchanging signals with an electronic computer. The computer feeds continuously corrected information into the guidance system of the missile at speeds measured in microseconds. Thus we have communication within the missile system happening at varying rates of speed with the man being the slowest element in the system in terms of reaction time. Even though the man is relatively slow in comparison to the computer, he is and must remain the dominant element of any weapons system.

How then can we assure his control and coordination of a system which operates at speeds faster than he can say "Garry Owen?"

The surface-to-air missileman's answer which is in process of emerging from present techniques is *visual communications*.

It would be less than candid in this appraisal of communications techniques and the philosophy of the people who are developing them, if I failed to point out that there are still a few people with the "hoss drawn" approach to solving the communications problems inherent in the modern missile system. Fortunately for the prospects of improving present techniques the old die-hard "muzzle loader" type who characteristically locks his mind and throws the key away when changes are proposed is rapidly being superseded by the imaginative type missileman described earlier.

There are still a few who are, as one missile-artilleryman expresses it, "going along fat, dumb and happy using EE-8 phones and field wire to control missiles worth thousands of dollars apiece." These few are really not slowing the pace toward push button warfare too much because they and their outmoded ideas are constantly being pushed into the background by the younger, more aggressive missileman who is willing to "try anything" in order to improve the SAM (Surface-to-Air Missile) systems.

#### Man-Machine Factor

In the guided missiles field, as in few others, is the imaginative approach so important? Man and machines must work as integral parts of the weapons system. Man with his five senses and his sixth sense, imagination, must devise ways to offset his disadvantage of speed when communicating with the relatively faster electro-mechanical devices such as digital and analog computer functions of the modern missile system.

In no other line of endeavor is the intelligence of man so closely coupled to the inanimate "black box." He is required to communicate commands and instructions to machines which have been glamorized in the press and on television as electronic "brains," but which are more accurately electronic "morons" capable of doing only and exactly what they are told by man. True, they can do it faster than man and in some cases can compute more accurately. In this fact lies an inherent barrier to communication between man and machine, their difference in reaction speed. (It is noted parenthetically here that this is only *one* barrier to communication. Another one is difference in language between men and machine. Men

are rapidly becoming bi-lingual, however, and are accumulating decks of cards and tapes prepared in computer language.)

Up to this point we have been dealing with the broader theoretical aspects of communication within the missile system and with the psychology of the missileman. Since the men and the machines are so closely related in the missile business, it is necessary to treat the man and his philosophy in any article dealing with the science of communications between the components which comprise the missile system. For whether we admit it or not, the man is a functional component of the missile system which must be in communication with all other components of the system. It is an historical fact that how a man thinks influences the method he will choose to communicate his thoughts.

#### The Quick Fix

The surface-to-air missileman in the Army today is concerned about (but not alarmed by) the relatively slow speed of voice communications. He seeks greater dependability, accuracy and speed in the communications which tie the elements of the weapons system together. He is constantly improving the techniques and is trying various combinations of hardware and techniques in his search for optimum flexibility of the weapons system. The term "quick fix" is becoming a household word of the missileman. As used locally, it means prototype arrangements of equipment components in the field which were never dreamed of by the inventor in the laboratory or the production engineer at the factory.

The missileman is characteristically ready to try out a "quick fix" technique of fire or procedure; he is ready to use even a "bread board" equipment which promises an improvement in his ability to perform his mission.

It is not surprising then that the missileman has begun to turn away from voice telephony to relay his commands and has taken one step nearer to push-button warfare by employing more and more "status lights" (colored lamps mounted on control consoles which indicate the status of this or that function) in lieu of voice communication.

The most common is the "ready-to-fire" lamp on the missile battery commander's console. Instead of going through a voice call up and answer procedure, it is an easier matter to wire up the system so that a button can be depressed on a piece of equipment at one location which will cause a lamp to be lighted at another location.

Similarly, a variety of machine functions can be used to activate status lamps at multiple locations throughout the system. A glance at these colored lights on a control panel can tell the missileman a variety of things about what is going on inside his own whirring monster, or about how the boys down at the launching pads are doing.

Surface-to-air missile techniques have *almost* (but not quite) progressed to the point where a complete status report on several complex operations can be received entirely by the sense of sight and without having read a word or heard a voice.

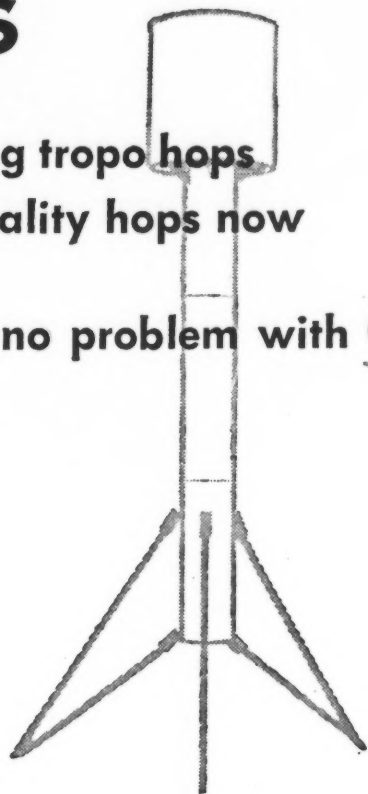
The new range control facilities for the missile ranges at the Army Air Defense Center are being engineered to make maximum use of visual status indicators.

When the man at the launcher is ready to fire he can push a button which will activate a green light on control panels of higher echelons. These higher echelons knowing (visually) the status of targets and other launchers may "over-ride" the green light with a red or "hold fire" light. The computers and other machine components can also

(Continued on page 52)

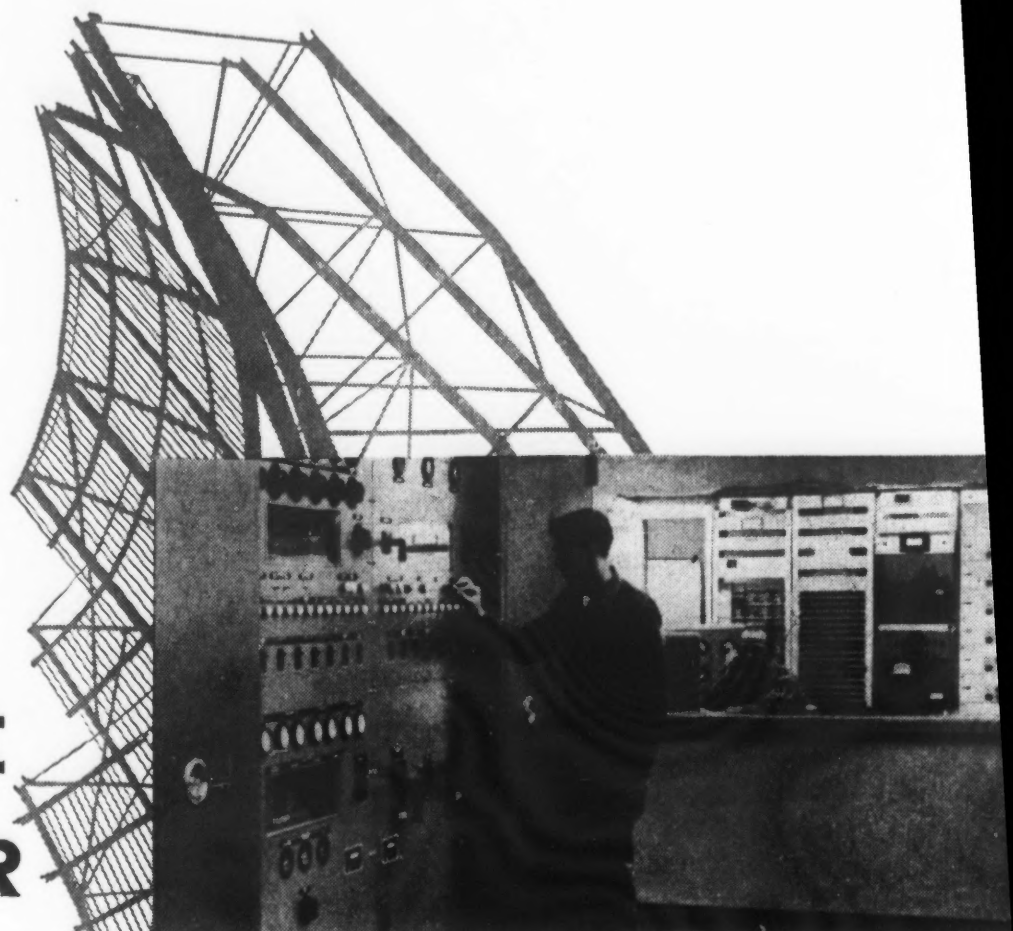
# FIRST LONG DISTANCE TROPO SCATTER SYSTEM PROVES

- SSB best for long tropo hops
- Longer high-quality hops now feasible
- High power is no problem with G-E amplifier

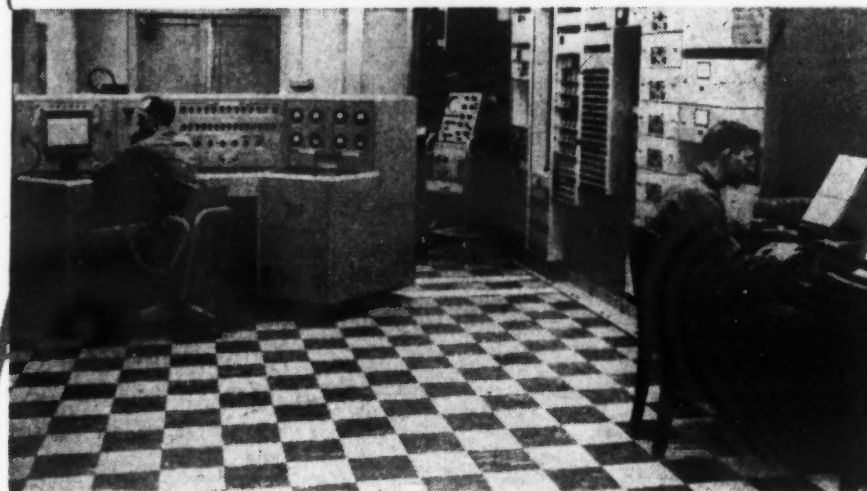


Operation of the world's first long distance single sideband tropospheric scatter system proves the practicality of SSB for over-the-horizon hops of several hundred miles. Spanning 640 miles between sites near Boston and Winston-Salem, multi-channel voice and teletype communications are maintained with high reliability.

With this system General Electric demonstrates the inherent advantages of SSB for long distance transmission: the ability to get more wide-band signal over long one-hop distances with less power, at less cost.



**Klystron power amplifier** of new design, featuring higher efficiency, reliability and lower operating cost. The entire system was designed by MIT Lincoln Laboratory in conjunction with Air Force Air Research and Development Command.



**Control room** showing control console and teletype machines. The system has been designed for ease of maintenance and operation to cope with extreme weather conditions.

When considering long-distance communications, remember General Electric's many years of experience in the design and manufacture of high power amplifiers, a key limiting factor in tropo scatter system design. And G-E engineers possess the practical system "know-how" so essential in the design and installation of long-range communication systems. Call these engineers to study your requirements. Military-Industrial Sales Technical Products Department, General Electric Company, Electronics Park, Syracuse, New York.

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

# COMMUNICATIONS MEDIA FOR SPACE AGE SYSTEMS

by Joseph L. Ryerson, Chief, Advanced Development Lab.  
Directorate of Communications, Rome Air Development Center  
Griffis Air Force Base, N. Y.

AS THE SPACE AGE develops and scientific abstractions are being translated into engineering realities, it is becoming increasingly apparent that existing global communications systems are inadequate to support the communications requirements of satellite and space vehicle systems. The rotation of the earth on its axis once every twenty-four hours, as well as its motion through space about the sun, makes it extremely difficult to maintain continuous communication contact with even a slowly moving lunar or space vehicle. This problem becomes even more severe when it is desired to maintain contact with a satellite moving in an oblique course relative to the earth's equator at a speed of approximately 18,000 miles per hour at an altitude such that the radio horizons of the vehicle do not extend more than 2,000 miles.

In spite of the extensive development of radio communications over the past fifty years, many problems have arisen due to the great number of users. In addition to resulting in severe technical problems involving crosstalk and interference, problems of military priority and communication traffic have arisen. In order to actually provide the military agencies with a global communications network in support of space age systems, it is imperative that these agencies be the sole managers of these facilities so that they may appropriately regulate communications traffic without conflict with the other using agencies. It appears impossible to accomplish this by the use of the radio spectrum alone since this is a resource common to all civilized nations. Consequently, it would be desirable to develop means of communication which do not employ the conventional radio spectrum and which therefore can become the sole domain of the military agencies. This paper will examine means of communications other than conventional radio and will summarize the types of media which could conceivably be employed.

COMMUNICATIONS MEDIA

Audible Sound	Air, Water, Rock	16 CY — 10 KC/SEC
Ultrasonics	Air, Water, Rock	10 — 100 KC
VLF Radio	Air, Outer Ionosphere Rock	1 — 100 KC
Present Radio	Air, Lower Ionosphere Rock	100 KC — 1000 MC
Microwave	Air	1000 MC — 1000 KMG
Infra Red	Air	100 KMC — 0.7 Microns
Visible Light	Air	0.7 — 0.4 Microns
Ultraviolet	Air	0.4 3x10 <sup>-4</sup> Microns
X-Rays, Gamma	Outer Space	3x10 <sup>-4</sup> Microns & Lower
Electrons Protons, Etc.	Outer Space	High Energy Particles

Table 1

Table 1 summarizes communications media which are available for military exploitation. These media embrace the entire electromagnetic and acoustic spectra as well as the physical media through which each form of energy may be propagated.

Study of the physical instruments required to utilize these media for communications reveals that regardless of the mode under consideration the same basic equipment problems, which are familiar to all communications engineers, present themselves. In the field of acoustics the familiar radio antenna is replaced with a horn or other transducer. In the case of optics the antenna becomes a large mirror or lens. In general, the gain of the "antenna" becomes greater as its physical dimensions become larger. The medium through which the energy is propagated is subject to the same geometrical loss as ordinary radio. In addition this medium contains undesirable noise sources which reduce the effectiveness of the system. The receiver is similarly limited by its own internal noise, generally of electronic origin, regardless whether this receiver is a photoelectric cell or an acoustic microphone.

The loss in the media may be summarized as follows: (1) *Geometrical spreading*—inverse square law and inverse first law; (2) *Heat loss*—attenuation per unit range; (3) *Natural noise within the media*.

An example of inverse square law spreading is an electric light bulb. In this case the radiation spreads over an ever increasing sphere as one recedes from the lamp. An example of inverse first spreading is the familiar transmission of HF radio by successive reflection between the surface of the earth and the under surface of the ionosphere. The confinement of the energy within this duct greatly enhances its range capability. In addition, there is one other form of energy confinement within a tube in which no spreading occurs. This is found very rarely in nature but is quite common in man-made devices. An example would be a speaking tube in the case of acoustics or waveguides and transmission lines in the case of electromagnetics.

### Line of Sight Systems

Those systems in which geometrical spreading is governed by the inverse square law are extremely range limited, both by the geometrical spreading of the energy and by the inability to receive the energy when the receiver is shadowed by an extensive obstacle such as the curvature of the earth. When curves of range vs. attainable system sensitivities are plotted, it is illustrated that acoustic and optical modes of transmission do not appear promising beyond a range of a few miles. Microwaves and infra-red are somewhat better attainable ranges extending to a few hundred miles. Conventional radio on the other hand is capable of ranges of a few thousand miles. This is primarily due, in the case of radio, to the very low absorption of the atmosphere and explains the great popularity and success of this type of communication. The range limitations of acoustic and optical systems are explained by the severe absorption of the atmosphere, particularly by water vapor in the case of sound and certain infra-red frequencies and in the case of

light by scatterings from many fine particles suspended in the air. Table 2 will summarize the limitations of these modes and will indicate areas that require development.

SHORT-RANGE MODES

Mode	Limitations	Required
Microwave	None	None
Ultra Violet	Sources	Sources Modulator
Particles Gamma Light	Excellent in Space Limited in Air	
HF Sound, in Sea Sound in Air	Range Limited	

Table 2

If one examines the line-of-sight ranges attainable from a 1200-foot tower situated on various celestial bodies, it is found that ranges attainable on the moon will be somewhat less than thirty miles; ranges attainable on Mars will be somewhere in the vicinity of forty miles. Therefore, use of this mode of communication in communication systems to be used on these bodies does not appear feasible.

Natural Ducts

In over-all view, if one examines the structure of the earth it is noted that it is made up of a series of concentric spherical shells of rock strata, water, air and ions. As was discussed earlier, reflection of energy by the interface of such spherical shells provides tremendous range enhancement for any type of communication transmission. It is possible to confine sound and very low frequency radio propagation within various rock strata. A very promising means of transmission of sound through the earth is at the interfaces of strata. Waves which are transmitted in this mode are called Stonely waves. It is very possible that the line of sight limitations encountered with conventional radio on the moon and other celestial bodies may be overcome by the use of the subterranean strata which compose these bodies.

A very interesting sound duct exists within the sea at a depth of approximately one kilometer below the surface. It is possible to transmit sound over thousands of miles through this duct and it is, in effect, in use by the Navy for long distance signaling. Directly above the level of the sea at both 200 and 7,000 feet altitude in the general area of the trade winds the atmosphere has a low index of refraction which results in the trapping of VHF radio transmissions. At an altitude of fifteen kilometers above the earth it is possible to trap sound which can be transmitted for thousands of miles between balloons.

Finally, the ionosphere forms an upper boundary and it is possible to confine HF and VLF radiation in the duct formed between the surface of the earth and the underside of the ionosphere. In addition, at much higher altitudes, variations in the density of the ionosphere may provide additional radio ducts of global extent. It has been shown theoretically and demonstrated by actual experiment that an infinite series of ducts exist between the magnetic north pole and the magnetic south pole or between any other two points situated equal distances either side of the magnetic equator. Very low frequency radio waves in the vicinity of ten to fifty kilocycles are trapped within a tube surrounding one of these flux lines, this tube being approximately 2,000 kilometers in diameter at the surface of the earth. In passing from the northern hemisphere to the southern hemisphere, the tube extends many thousands of miles out into the space surrounding the earth thereby making it possible to use these ducts as a means of transmission to space vehicles. The losses in this duct are so low that radiation from lightning discharges has been observed to traverse the duct, to re-reflect from the surface of the earth from the opposite hemisphere and then to return to its point

of origin—this reflection occurring many times.

Calculations based on the sensitivity of available equipment indicate that very low frequency radio ducted in the atmosphere and very low frequency sound ducted in the sea can attain ranges of several hundred thousand kilometers. In addition, high frequency sound of the order of five kilocycles ducted in the sea may be transmitted for several hundred kilometers. Although the above noted communications media are of tremendous range capability, they all suffer from bandwidth limitations since the center frequencies, in all cases, range from a few hundred cycles to about fifty kilocycles. Due to their low frequency the wavelength of the radiation becomes quite long, particularly for the electromagnetic modes and consequently require extremely large conventional antennas or acoustic transducers. It is conceivable in the case of low frequency radio that imbedding the antenna in a shell of ferrite-like material could result in a great reduction of size as well as an improvement in bandwidth. This has been borne out to some extent by experimental work. The use of ferrite cores in radio receiving antennas has met with considerable success. This material has the property of reducing the velocity of propagation, thus reducing the wavelength. Due to the reduced wavelength it is possible to reduce the dimensions of the antenna.

Table 3 will summarize limitations of these long-range modes and will note the areas in which development is required to make effective use of them.

LONG-RANGE RF MODES

Mode	Limitations	Required
VHF Equatorial	Weather	Terminal Equipment
VLF Atmosphere	Radiators Bandwidth	Matching Encoding
VLF Rock Strata	Severe Dissipation	Not Feasible
LF Sea	Long-Range Audio Modes Cavitation Reverberation	Radiators Encoding
Rock Strata	Bandwidth Dissipation	Radiators Data
Upper Atmosphere	Bandwidth Multipath	Data

Table 3

Conclusion

The various modes of communications proposed are not being exploited at the present time because of difficulties due to lack of feasible terminal equipment, difficulty in acquiring traffic capability due to bandwidth limitations, and lack of basic physical data on the characteristics of the media of propagation.

It is felt that the focus of modern technology on the problems cited could result in releasing many of these modes for use and sole management of military agencies. This would alleviate the additional burden imposed upon present ground communications systems in support of the space age systems now undergoing development. Some of the modes cited, (e.g., VHF radio and low frequency sound in the sea), are now being used to some extent. It is felt that the full potential of these modes is not being realized due to the lack of intensive development work.

One of the promising modes of communications is by the use of ultraviolet. Due to the absorption of these frequencies emanating from the sun by the earth's atmosphere, the ultraviolet noise at the surface of the earth is practically nonexistent. Due to the very high frequency of this form of radiation it could conceivably support a tremendous communications traffic which would offset its disadvantages

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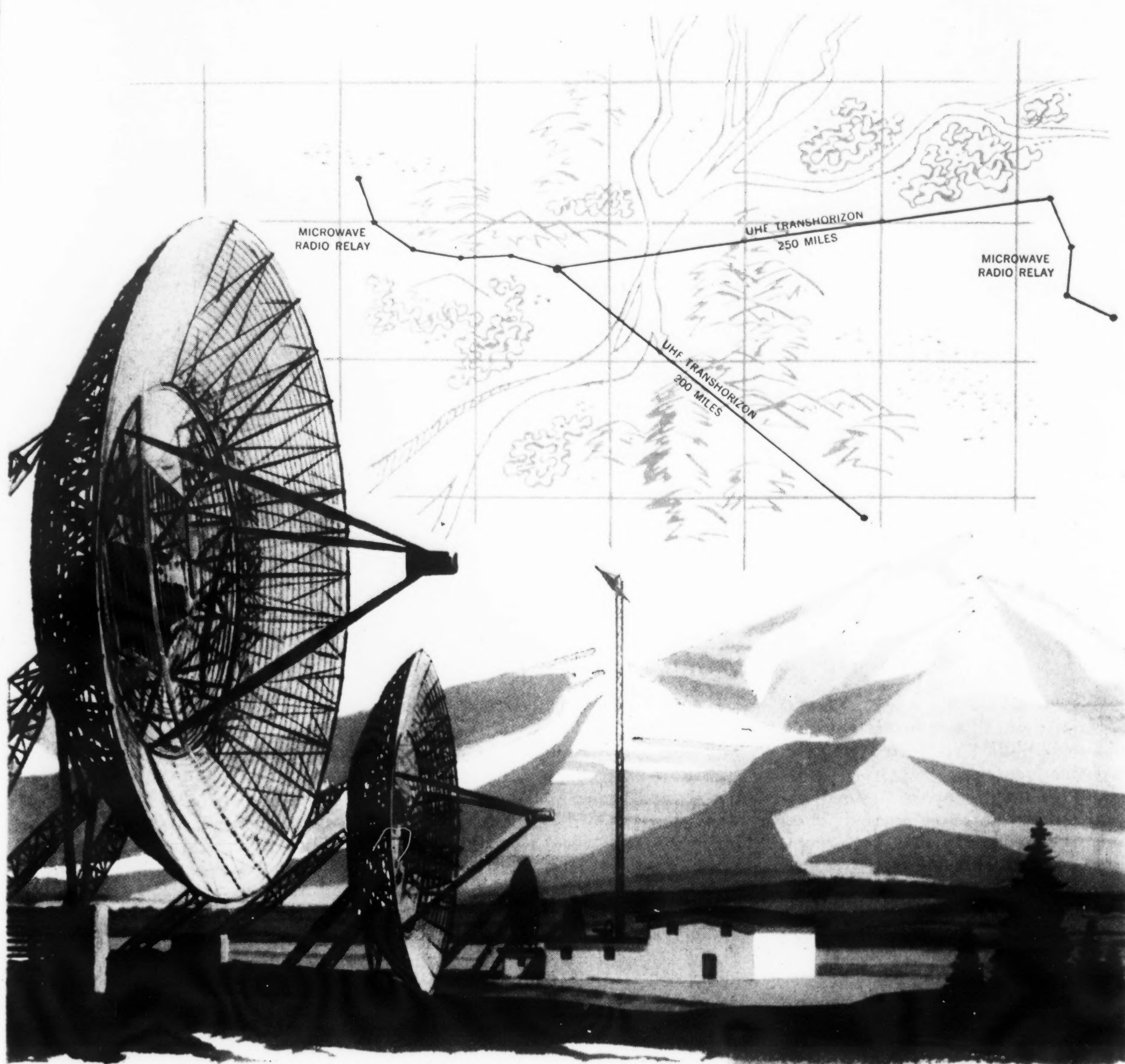
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## KEY TO A SUCCESSFUL SYSTEM

Planning and executing a modern radio communication project, such as this Microwave and Transhorizon system, requires expert assistance from many professional fields. By placing your project in the hands of one contractor who is qualified in all of its many facets you gain integration of system components, coordinated effort and improved efficiency. Collins maintains an organization of electrical, mechanical and civil engineers

devoted exclusively to systems.

The Systems Division is organized to perform all phases of a project—planning and design of radio facilities, site survey, antenna erection, construction of buildings and access roads, provision of primary power, equipment installation, linkage with other communication modes, maintenance, and operation. The division executes all or any portion of ground and airborne communication and navigation

systems, including UHF and VHF Transhorizon, HF Single Sideband, Microwave, and VOR.

Although backed by the manufacturing and research and development facilities of one of the foremost electronics companies, this systems organization is not restricted in its selection of radio equipment. This policy assures the customer of the optimum system configuration for his specific requirements.

**COLLINS** CREATIVE LEADER IN RADIO COMMUNICATION SYSTEMS



COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

SIGNAL, NOVEMBER, 1958

41

FOR A GOOD MANY YEARS, the great effort in new Signal equipment has been centered on maximum efficiency, ease of operation and compactness.

This has gradually led us to a veritable nightmare for the repairman. He has been constantly faced with smaller and smaller components, transistors, printed circuits, etc., and the necessity of learning ways of isolating and correcting more complicated troubles.

Our research people will tell us that, with improved methods of production and better components, the outage time of the newer equipments

Supply grow to some 150,000 line items covering a vast range of equipments which were totally unknown to our forefathers.

We have seen the introduction of electrical accounting machinery which has made such growth possible and which has enabled us to keep track of our vast inventory both location-wise and dollar-wise.

We are now seeing the beginning of a new automatic data processing system—a system which will greatly cut the time now required to process a requisition from the unit level (over-seas or Z1) to the Z1 Depot

balance our use of these methods with industrial capability.

Next, the training of the equipment operators as semi-skilled technicians is another possible solution to our future maintenance.

#### **Critical Areas**

Here we are faced with three problems: the time available for training, the type of personnel available, and a very critical shortage of operator personnel spaces in our new TOE's.

The time element is important because a future war may be not only sudden but of relatively short dura-

## **EFFECT OF MODULAR DESIGN UPON SKILLED**

will be less. On the other hand, in both civilian life and the military, the repair business is increasing by leaps and bounds.

A 1957 (Oct.) issue of *Time Magazine* had an interesting and enlightening article on the civilian repairman. From less than 1,000,000 in 1940, there are today almost double the number of repairmen—1,800,000. This is big business with the bill rising above \$16.6 billion—almost \$100 per person in the United States per year—and the trouble seems to be because modern technology is surpassing the U. S. repairman.

The Army has this same problem. The company mechanic of yesteryear has been replaced by a host of school trained individuals of varying degrees of ability.

#### **Factors in Future Training**

Before getting into the training field I should like to discuss the various factors which will have a bearing on the type of training we will require in the period 1970 to 1980 and how far modular design and other factors will affect us.

The supply people speak lovingly of "positive" supply to the field. Having been associated with supply in the past and knowing something of the problem, I feel that I can speak with some degree of assurance on this subject.

We have done much to improve our system since the beginning of World War II. We have seen Signal

and back to the requestor. With such a system centrally controlled we will be able to eliminate many of the substitute items now purchased and maintained because we have no idea where the standard item can be found in the system. All of this adds up to a closer realization of positive supply.

At the present time the 7th Army requires between 5500 and 9,000 fast moving repair parts to maintain its Signal equipments—an average of about 7,000 items. With the introduction of modular design and sub-assemblies this line item figure could possibly be reduced numerically to almost half, but it is probable that supply tonnage and dollar value will be greatly increased.

The present cost of Signal equipments in a typical Army exceeds 80-million dollars with an annual part support cost of close to 5 million.

With the continual development of new and better equipments we can visualize an army of the future with double the value of equipments and a substantial increase in repair parts even with the introduction of a greater percentage of sub-assemblies and modular design.

One thing we cannot overlook in the extensive use of sub-assemblies is the fact that while in time of peace replacement by this method is good for industry, in time of national emergency such replacement may not be economical from a standpoint of full utilization of our industrial capacity. We must therefore carefully

tion. This necessitates training our operator personnel quickly and getting them to the field as soon as possible.

The personnel selected for operator training are generally quite a different type of individual from the maintenance men, both in background and aptitude, as well as manual dexterity.

Finally the present Tables of Organization for the support of the reorganized divisions are woefully short of operator spaces. The operator teams are cut to the bone and are so thinly spread as to make displacement requiring advance and rear parties difficult.

This latter situation may be alleviated if the application of modular design to Signal equipment will result in the same 80% reduction of repair time that Ordnance has experienced in the missile field.

Making units that can easily be replaced saves time in repair. However, it does not mean that a skilled repairman is not needed. It may only mean that the repairman can more easily and quickly perform that part of his job that always has been the manual skilled part: disassembly, unsoldering, etc. Interpretation of trouble symptoms and the use of logical procedures in isolating defective stages will still require the skilled man.

It seems probable that repairmen, up to third and fourth echelon level, will continue to be needed in the

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forward combat zone for such tasks as alignment, balancing, calibration and other delicate tasks which undoubtedly have to be done whether modules and modular design are used or not. Without these third and fourth echelon teams, items needing only minor repair would have to be evacuated some distance to the rear.

When we think of warfare of the future, with divisions spread over areas formerly occupied by Armies or Army groups and then speak of evacuation of equipment to some rear area, we find ourselves faced with an enormous problem. In spite of im-

whether they will change too radically in the next few years. For these equipments we will still be required to continue training maintenance personnel at the same skill level as at present.

Since the field of electronics is still expanding at a tremendous rate and extending into every type of activity, the need for repairmen may well be on the increase. Under the new "Pen-tomic" concept, a tremendous amount of electronic equipment will be utilized at all levels with probably a most significant increase in the forward areas.

Operation Speciality) will be assigned to module repair from the mechanical angle. Thus, the technician will analyze and isolate the trouble to a component while the module repairman will perform the necessary mechanical operations to effect repair.

We are faced now with a shrinking source of personnel. Ten years ago we had less difficulty in obtaining personnel who were trainable in the repair field. The demand was not very great and the equipment was comparatively simple.

Today, we find ourselves in a highly competitive market. Not only

## TECHNICIAN REQUIREMENTS

by Col. Royal S. Copeland  
US Army Signal School  
Fort Monmouth, N. J.

provements in equipments and in requisitioning procedures, there remains one big stumbling block for "positive" supply—transportation.

World War II found Corps and Divisions with less than 15 rounds per gun and only 1/3 of a ration on hand. We were short of bottoms and had little capacity for airlift. Even more serious, due to enemy capability, our supplies and troops were delayed, sometimes as much as 45 days, while awaiting escorts.

How different will this situation be 10 to 20 years from now? We may still find ourselves with a critical lack of lift capability. We probably will find situations where the enemy has air and sea superiority. If this is possible then we must be in the position of having trained maintenance personnel to continue the job, even down to the forward echelon. Without "positive" supply we cannot consider the total elimination of the trained repairman.

### Modular Design

From the production standpoint modular design may not be economically possible for all Signal equipments. There are many Signal items which do not lend themselves readily to modular design (telephone central office equipment—overseas transmitters and electro-mechanical equipment are some examples). Since many of these equipments are almost commercial in nature, rather than strictly military, it is questionable

Since the matter of equipment out-age time will be more critical than visualized previously, it will be extremely important that the decision of the personnel in the lower echelon levels in relation to malfunction correction be extremely quick and accurate. Thus, these people will have to be trained in rapid and accurate analysis of trouble indications on a module basis.

It should be remembered that the wiring interconnecting the modules in a unit of equipment may develop trouble. This also holds true for auxiliary circuitry. Correction of such defects will require a high level of technical skill.

How far forward the repair of modules will be feasible will depend on the production cost versus repair cost ratio. Small encapsulated modules with long life expectancy will be best replaced on a unit for unit basis. Provided that a supply of spares is on hand, this type of maintenance can take place in the most forward areas.

Some repair of modules may be feasible in forward areas, depending on their size and complexity. Such repair may be found necessary where units are isolated from all support. This would mean the utilization of skilled technicians in forward areas.

The level of mechanical skill required in the repair of modules will probably be greater than now required of technicians. It is conceivable that a special MOS (Military

has the Signal Corps expanded its requirements for electronics personnel, but Ordnance, Artillery, the Air Force and the Navy have also developed a greater demand.

This increasing demand for personnel, not only by our sister services, but within the Signal Corps itself, may very well make it difficult to support the repair effort at the forward echelon in the same manner in which we are now accustomed.

At the same time that the electronics field has developed by leaps and bounds, the educational field has progressed at a snail's pace. If we seem to be sliding back two steps for every forward one, what will our personnel situation be 10 or 20 years from now? Education or the lack of it in the U. S. today is subject to a great deal of criticism. The average parent insists that his children receive the advantages of a "better" education and yet our society does little to improve the conditions under which this infusion of knowledge is supposed to be given.

No matter to which part of these United States you travel, you will find deplorable conditions in school facilities. Most classrooms are overcrowded. A large percentage of the school buildings are obsolete, or at best obsolescent. The average teacher is overworked and underpaid and many resort to other employment to make ends meet. Because of large classes, the student does not receive

(Continued on page 45)



## Is it possible to build a **MAN?**

"Theoretically, yes," said the scientist. "Or a reasonably remarkable imitation—a kind of mechanical analogue. Call it a habit machine, a mechanism operating according to the laws of the conditioned reflex."

*You mean that you could actually build a mechanical mind? One that would exhibit emotions—such as love, fear, anger, loyalty?*

"We're doing something like that now in advanced missile development," the scientist replied. "In a limited, highly specialized way, of course."

"Take the 'pilot' that is being developed for the big long-range missile. *He* has a wonderful memory, and can solve many complex navigational problems in a flash. *He* loves perfection, and actually becomes highly excited when *he* gets off course. *He's* a tough-skinned character, impervious to the cold at several hundred miles altitude and the incredible heat at re-entry. And *his* loyalty is heroic. *His* life is a single mission, the mission *his* whole life...and maybe ours, too. *He's* a pretty important fellow."

*What about the complete man-made Man? What would that entail?*

"A mechanism the size of the capitol in Washington, and the best scientific resources in the world. But it could be done. You see, it's only a question of how physical matter is organized. As a great biophysicist explained, 'If material is organized in a certain way, it will walk like a man. If it is organized in another way, it will fly like a missile.'"

*Still, wouldn't there be something missing in the complete man-made Man—something very important?*

"Yes," said the scientist. "A soul."

**MARTIN**  
BALTIMORE · DENVER · ORLANDO

SIGNAL, NOVEMBER, 1958

## Effects of Modular Design (Continued from page 43)

the individual attention required to motivate him and the teacher requires little or no home assignments since he does not have the time to correct this type of work.

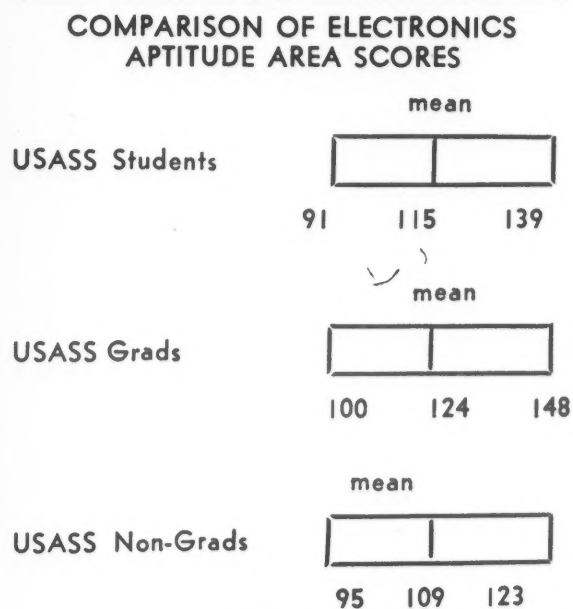
Since it is difficult for the average American to recognize willingly that different individuals have varying abilities, the student with high capability often finds himself held back by the dullards in his class. The result is a stifling of motivation which eventually becomes habitual.

After sitting as a member of the USASCS School Faculty Board for some 18 months and reviewing over 900 individual cases, I am continually amazed at the product of our average high school and am beginning to wonder whether we should not repeal the child labor laws. Too many of our youngsters seem to spend 10 to 16 years in being exposed to courses of instruction in school which apparently do not fit them properly for a place in our society. They lack ability to read, to grasp the fundamentals of arithmetic or science—worst of all they have never formed the habit of properly applying themselves to learn the task at hand. They do not know how to study or how to get the most out of life.

And yet these very same individuals—for the most part—have the native ability to learn electronics and, if properly guided, to be good. Unfortunately we do not have the time or money to undo what years of misguided public-school education has accomplished.

### Educational Aspects

It is well established that the level of education of students entering the U. S. Army Signal School is related to end of course grades in specialist courses. For example, the failure rate in the Field Radio Repair course was



more than twice as great for students who had not completed high school as for high school graduates. Yet, we are faced with the fact that many of our students come to us with less than a high-school education.

Chart 1 represents the range of electronic area aptitude scores for the U. S. Army Signal School students as a total group, and then for graduates as compared to non-graduating students. Each of the horizontal bars represents the range of scores in the electronics aptitude area for approximately 95% of the personnel in each group. For example, about 95% of all enlisted students in the U.S. Army Signal School will have an EL score falling somewhere between 91 and 139, with the mean score being 115. The other 5% will fall either above 139 or below 91. Similarly, about 95% of the enlisted graduates in the School at any given time will have EL scores falling between 100 and 148, with a mean score of 124; and about 5% of these graduates will fall below 100 or above 148. In the non-graduating group, about 95% of the students fall between 95 and 123, with the mean score being 109. Again, about 5% of these failing students will have scores above or below 123 and 95.

You will notice that a majority of the non-graduates have an aptitude score equal to that of graduate students. If this is so, then why did they fail to graduate?

COMPARISON OF CIVILIAN  
EDUCATION BACKGROUND  
Years of Civilian Education

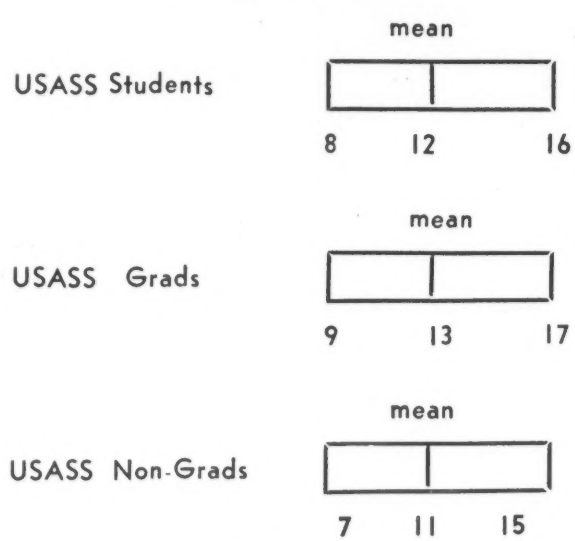


Chart 2

One aspect of the answer lies in the information which you see on chart 2. Once again these bars refer to approximately 95% of the students in each group, with the other 5% falling below or above the extreme scores on each end of the bars. You will observe that the average graduating student has 13 years of formal civilian education, whereas the aver-

age failing student has 11 years or less than a high-school education. This difference is another aspect of graduate and non-graduate status which implies that we must look at all facets of the students' backgrounds to gain some understanding for the reason of failures.

The fact that success in courses seems to correlate better with years of education than with EL scores indicates the need for further investigation to find out whether the relationship between high-school graduation and success in training is one of cause and effect, or whether the correlation only suggests that we may be loading the dice in favor of high-school graduates by using methods and approaches that are still too academic. We need also to develop better methods of predicting success or failure, better instructional methods and better training materials.

Significantly, even among those who do graduate from high school, serious shortcomings in *quality* of education exist which affect our training task. The lack of ability to grasp fundamentals, to master the essentials of mathematics and science is definitely related to the inability to cope with the material presented in our electronics courses. Our study has demonstrated that, in Field Radio Repair, the failure rate was more than twice as great for students who lacked algebra as for those who had taken this course in school. The findings were similar for geometry, chemistry, and physics.

It is obvious that students who are better prepared educationally will fare better in our courses. This does not mean that the solution for attrition is to raise educational requirements. Such a step does not automatically produce better students, but they must still come from enlistments and the draft, and the caliber of the individual trainee remains the same.

#### Looking for Solution

Here at Fort Monmouth, we have been trying to find a solution to our training problem. Some time ago we started a study of Marginal Personnel (the STOMP Study) using Field Radio Repair as a vehicle. We are endeavoring to find out several things.

First: What selection criteria should be used to predetermine whether an individual is capable of absorbing electronics training, and at what point does it become doubtful that an individual can be trained?

Second: In what manner can we improve our training? Should we teach more theory and less practical work, or vice versa? How can we best

test our product and our methods to improve our system?

Next: Should we lengthen or shorten our courses? Should we have two different levels of instruction to take care of the bright student?

Another possibility arises. Men who know geometry and trigonometry fare better than those who do not. This may be because our courses favor those with such knowledge, not necessarily because such knowledge is essential to good maintenance men. The question that begs to be answered is: How well can a man be trained without even mentioning mathematics more complicated than multiplication and division?

When we complete this study we hope to be in a position to definitely define the type of personnel we need, to have a training program which will do a better job than we are doing today, and to have text material which will make the work easy for these selected individuals.

In conclusion I should like to present certain assumptions for your consideration:

(1) Modular design cannot be fully realized in the next 20 years because of limitations on the type of equipments that can be so designed both from a cost and from a desirability standpoint.

(2) "Positive" supply cannot be insured due to probability of enemy activity coupled with difficulties of evacuation for repair.

(3) Reorganized divisions, to keep flexible, cannot be overburdened with large quantities of replacement units.

(4) The availability of personnel who are trainable will be seriously limited.

If we accept these four assumptions in whole or in part we accept also the fact that the training problem will not lessen but will become more critical. It means we will have to spend more effort on fewer individuals and develop a higher caliber of technician than we have today. We will have to produce an individual repairman who will be much closer to the electronic engineer as we know him today than the repairman we now turn out. We must continue to plan maintenance down to the forward echelon, keeping in mind the vast areas we will occupy. This may even result in having a larger number of repair personnel to give us proper coverage rather than fewer individuals at a rear echelon of repair.

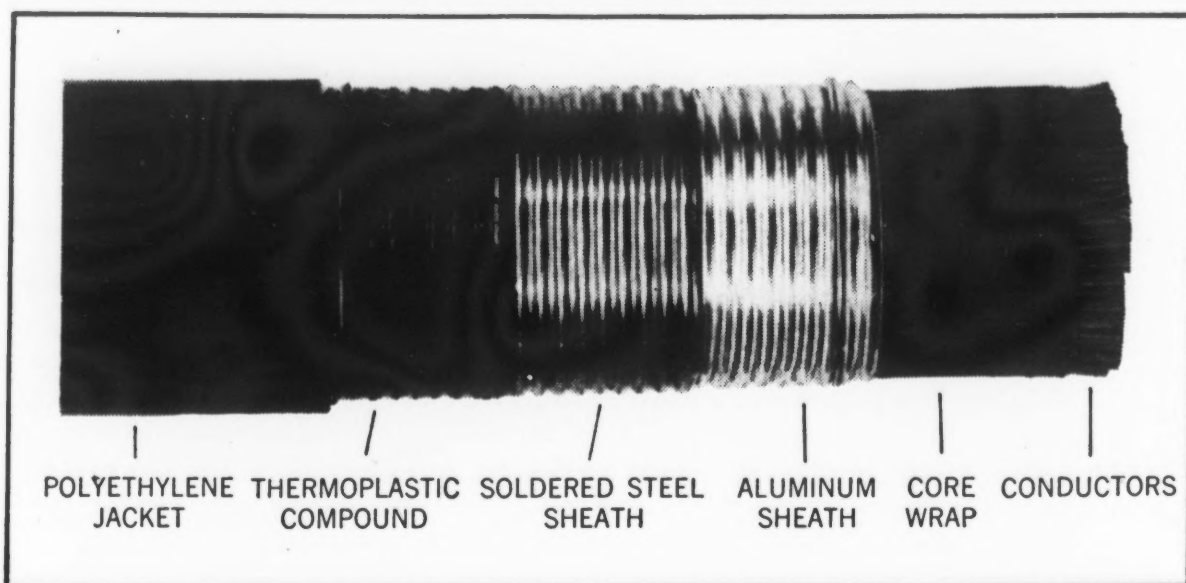
It is an intriguing problem which may change radically as the equipment itself changes.

# How wall thickness of polyethylene sheath is measured by electrical capacitance

Even though they're no bigger than your arm, telephone cables may contain over 4000 wires and can carry over 2000 conversations at once. Western Electric protects these vital cables by shielding them primarily with aluminum, steel, and extruded sheath of high molecular weight polyethylene.

To assure proper application of each material, highly accurate non-destructive test systems were quickly established for all components but one. Unfortunately, the thickness of the polyethylene sheath could be determined only after it was applied . . . and then only by cutting through it.

But cutting and measuring the sheath a few inches from the ends of a cable, which could be up to a mile long, provided far too small a sample for accuracy. So Western Electric en-



This typical telephone exchange cable contains 4242 insulated wires in its core. They are protected by paper, aluminum, steel, thermoplastic compound and, finally, with a polyethylene sheath.

gineers set out to find a way to measure distances from the outer surface to the inner surface without visually locating this inner surface.

They considered several approaches that might allow non-destructive testing on a continuous basis. Two looked promising—X-ray and measurement of electrical capacitance.

Both offered challenging problems—X-ray presented difficulties in protecting personnel and in application . . . and the capacitance method required precision to an order of magnitude beyond any then available. The latter method was ultimately selected because it had better potential for accuracy under production line conditions.

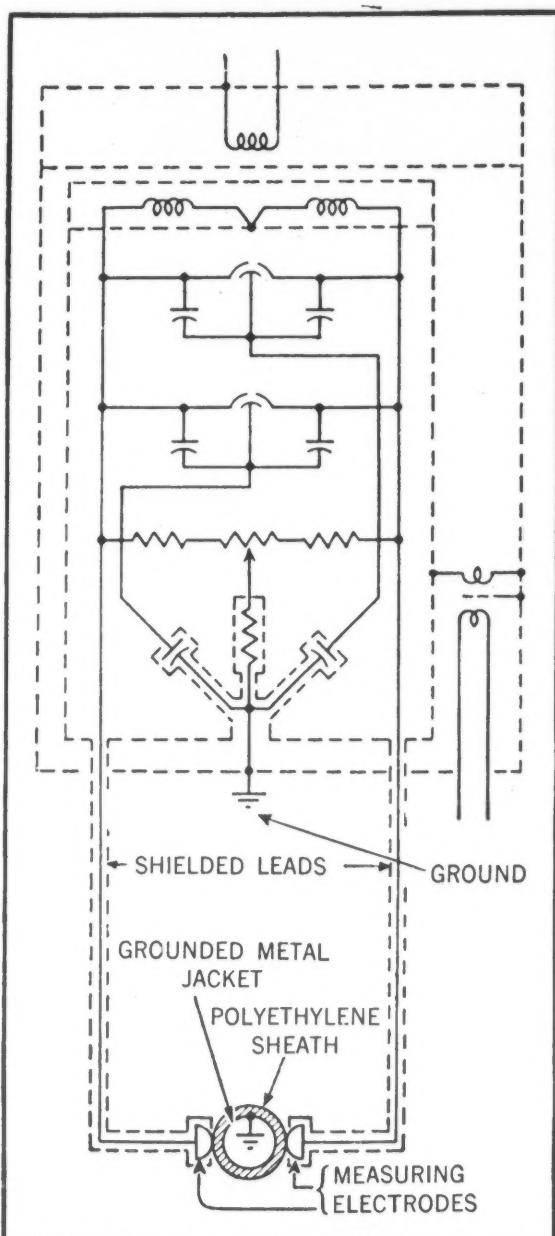
Essentially, the capacitance test determines thickness by establishing an electrical charge between a metal contact against the sheath's outer surface and the inside metal shielding, and measuring differences in voltage or electrical force required to maintain this charge.

In designing equipment that would make this test on the production line, Western Electric engineers faced two problems which could result in great inaccuracy. One was noise or stray electrical impulses; the other, the presence of unwanted stray capacitances. If not solved, these could work harm by obscuring and distorting the truth to be learned from the measurement. Such troubles are ordinarily overcome by the use of protective

electrical shielding, so arranged as to intercept unwanted signals and conduct them to a point where their effect is nil. Application of this technique in the present case was accomplished by a specially developed circuit which employs double shielding. An inner shield protects the critical measuring conductors from stray capacitances and connects to a non-critical point; and a grounded shield protects the entire assembly from unwanted random impulses.

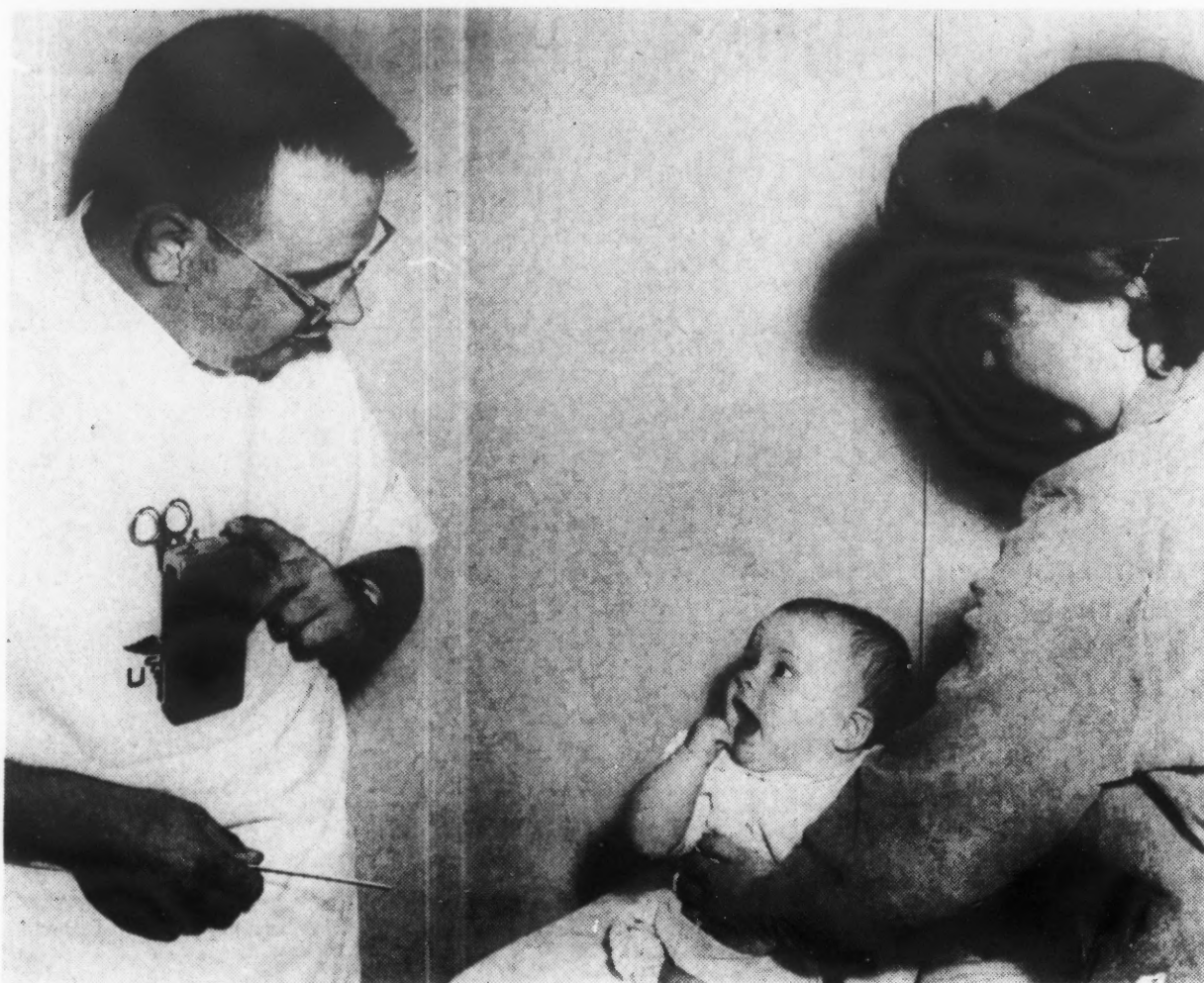
This plus other innovations resulted in test equipment that maintains a circuit stability that would be difficult even under good laboratory conditions.

Western Electric is sure of the thickness and quality of the cable's vitally important polyethylene sheath. In addition, as is so often the case with engineering achievements, other equally important advantages were gained. The improved quality control permitted the elimination of a 10% safety margin in jacket thickness, which resulted in a saving of nearly a hundred dollars per mile of cable. It is one more example of how the wide-ranging creative and applied engineering activities of Western Electric are helping the Bell System serve you better and more economically.



Simplified schematic of measuring circuit, showing special protective shield (broken lines).

**Western Electric**  
MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

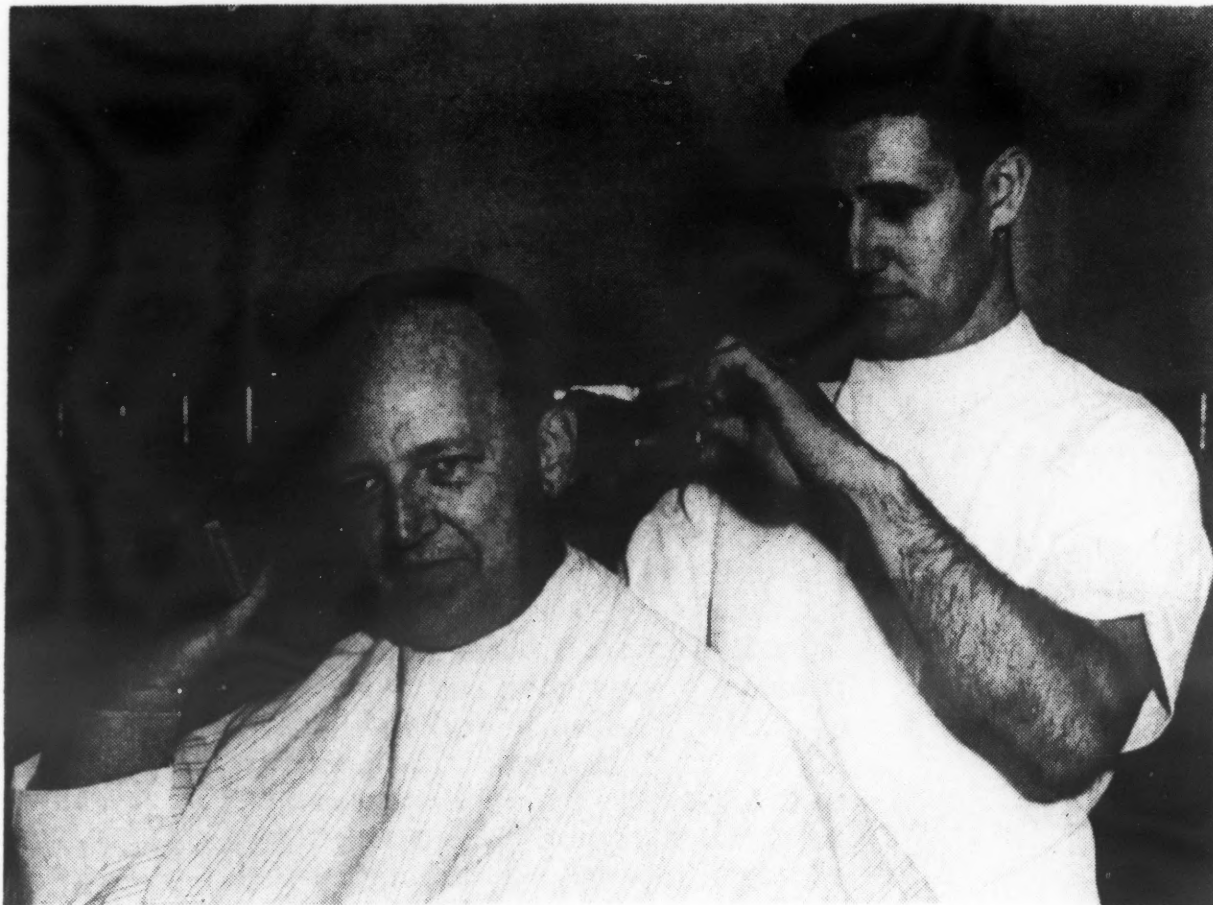


Technician listens to message over paging receiver.

## PAGING BY RADIO . . .

■ ■ ■ *Fort Belvoir Hospital Communications System*

Dr. Frank Von Wagoner, chief, surgical services, always can be reached.



by Lee Weddig  
Communications and  
Electronics Div.  
Motorola, Inc.

**A**N ARMY FIRST has been scored at the DeWitt Army Hospital, Fort Belvoir, Virginia, in the form of a new mode of intra-hospital communications. The familiar squawk box or bell and light systems of paging have been abandoned in favor of a private, selective method of radio voice paging.

The system, installed by Motorola Communications and Electronics, Inc., of Chicago, Illinois, consists basically of a central, low-power FM radio-transmitter and small individual radio receivers worn by key administrative and medical personnel.

When it is necessary to page a particular person, the Information Desk Clerk presses the appropriate button on the central control. This causes the transmission of a radio signal that actuates the Motorola "Handie-Talkie" pocket pager worn by the desired individual, producing an individually selective alerting tone. The operator then transmits the voice message.

Since each personal receiver responds only to its particular signal, the entire system is selective. Only the person desired hears the tone and the subsequent voice message.

In recent months, this type of paging has gained rapid acceptance and is in use in scores of civilian hospitals across the country; however, DeWitt Army Hospital is the first U.S. Army hospital to make use of it.

DeWitt Army Hospital is a Class I hospital built in 1957 to care for military personnel and dependents of the U. S. Army Engineer Center and Fort Belvoir, as well as for all military personnel and dependents living in Northern Virginia south of the Potomac River.

The five-story building has a 350-bed capacity, with a present daily occupancy average of 268. It performs very extensive outpatient work, serving about 500 persons per week in the Obstetrics Clinic alone.

Since successful hospital management makes it mandatory to maintain constant contact with key staff members throughout the 24-hour hospital day, the value of DeWitt's radio paging system is evident.

DeWitt Army Hospital utilizes thirty-one individual paging receivers. These are kept at the information-reception desk in the main lobby of the hospital. When a doctor, nursing

supervisor or other administrative official arrives for the day, he or she checks out one of the receivers, signing his or her name on a sheet opposite the number of the receiver taken. When the individual leaves the hospital, the receiver is checked in, freeing it for use by personnel of the next shift. This saves in the number of receivers needed and provides an opportunity for maintenance checking to insure proper working conditions.

If during the day, for example, the doctor from Ward Three wishes to consult with the Chief of the hospital's Surgical Service, he merely calls the desk and asks that the Chief, Surgical Service, be paged. The clerk on duty checks the pager roster and sees that the doctor being called is using pager number 116. The clerk presses the corresponding button on the control box and then announces: "Chief, Surgical Service, you are wanted for consultation in Ward Three."

The clerk, knowing that the Chief, Surgical Service, has received the message, lets him make the decision whether to call the ward saying he is tied up or to comply with the request immediately. More often than not he would so comply; however, if he were involved in important work of some other type, he might just phone the ward to inquire as to the nature and the urgency of the problem.

If the staff member in Ward Three were involved in an emergency, he would ask the clerk to obtain verification of the page. In this case, at the end of the message to the Chief, Surgical Service, the clerk would add: "This is an emergency, please verify." Such a message would be repeated every thirty seconds until the Chief, Surgical Service, verified its receipt by calling the desk.

In a hospital the size of DeWitt Army Hospital, the Motorola Paging System is in constant use. The clerk reports sending a page about every five or ten minutes.

While the system is in use 24 hours a day for all types of calls, the greatest need is from 7:00 P.M. to 5:00 A.M. Whereas there is at least one doctor and one nurse supervisor on each floor during the day, there is only one medical doctor, one surgeon, one nurse supervisor, and one administrative officer assigned to the entire hospital during the evening and night. It would be very difficult to locate these very important persons without a system such as radio paging since they could be anywhere in the building at a given time.

During the day, the Motorola system is extremely valuable in connection with the large outpatient load of the hospital. Ward doctors divide their time between their wards and the clinics and constantly travel back and forth as needed. The paging system reaches them immediately in either location or when they are traveling between the two spots. Particularly useful in cases of emergency, the radio pager eliminates telephone delays, saves time and increases efficiency of hospital operation.

While the value of the radio pager in emergencies can readily be seen, most calls transmitted are of a routine nature. It is in this field of normal activity that the greatest benefits are reaped: time is saved for all involved; each message is assured of reception; the system preserves the privacy of both physicians and message, and staff members are freed from the annoyance of receiving messages meant for others—an inherent evil of public-address paging.

Electronically, the Motorola network is a low-power frequency modulated radio circuit. Its low-power characteristics forego the necessity of a Federal Communications Commission license. Selectivity is obtained through vibrating-reed tuning-fork type devices, called "Vibrasender" and "Vibrasponder" units.

When a button is pressed on the control box, it actuates its particular "Vibrasender" unit. Its tone is radio transmitted and received by all pocket pagers; however, only that receiver incorporating a "Vibrasponder" device whose frequency corresponds to the tone sent will respond with the alerting signal. This in turn notifies the person using this pager to press a button which will open the receiver's speaker to the voice message.

The paging receivers themselves are compact transistorized units, fitting into a shirt, jacket or dress pocket or clipping onto a person's belt. They are powered by a mercury cell battery and weigh only ten ounces. The antenna for the system is a wire loop installed on the building's roof.

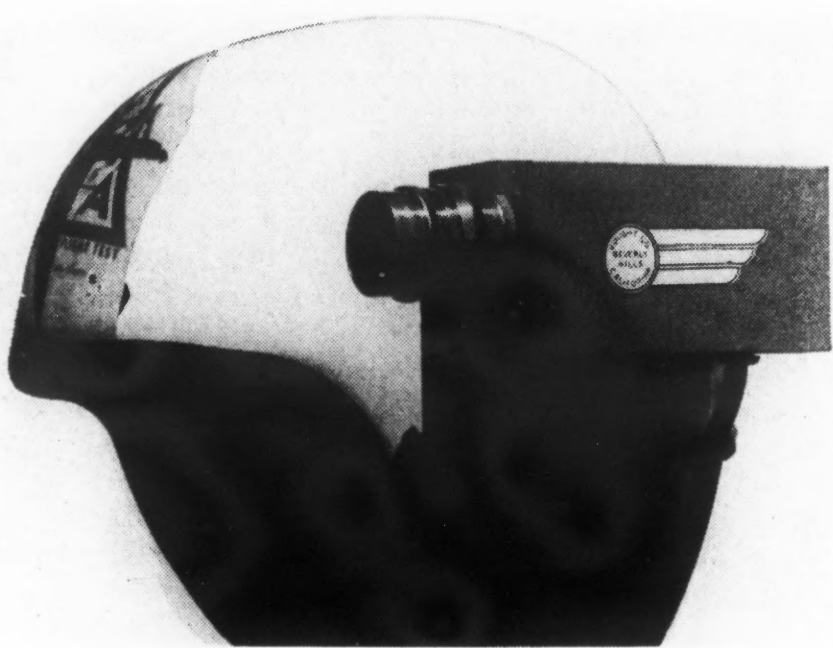
Maintenance for the entire system is provided by the Signal Corps which also services all other electronic communications equipment in the hospital. The system has been received by all DeWitt staff members with marked enthusiasm.

One statement volunteered by a nursing supervisor perhaps is the best description of the staff's reaction to radio paging: "It lets you find someone when you need him."

# photoprogress

by FRANK SMITH

SIGNAL PHOTO EDITOR



## Vought VDR-1630

With nearly everything being placed in headgear these days, it was inevitable that a motion picture camera would be next. Of course, the idea is not entirely new. A still camera was placed in a hat at the turn of the century and operated as a so-called detective camera.

The new motion picture camera is a recent product of the Vought Co., P. O. Box 1350, Beverly Hills, Calif., and is called the Vought VDR-1630. It is a very small, compact and lightweight 16mm electrically operated photographic recorder designed especially for use on pilot's protective helmets. According to the company, the camera provides the answer for many photographic data recording problems which feature small space and light weight.

The camera accommodates any ASA "C" mount lens and operates at 24 frames per second at 24 volts DC. Size of the camera is only 2" x 2 1/4" x 5" and the weight, 18 1/2 oz. Capacity is 30 feet of 16mm film.

## High-Speed 16mm Air-Borne MP Camera

A recent entry in the field of high-speed photographic instrumentation cameras is a compact 16mm air-borne instrument which shoots 200 frames per second, holds 200 feet of film on daylight loading spools and weighs only 6 3/4 lbs. loaded.

A development of the Traid Corp., Encino, Calif., the new camera, which is called the Traid 560 Fotomatic, is 8" long x 5 3/4" wide x 6 1/4" high and withstands acceleration to 25 G's.

Continuous or intermittent operation is provided by the camera's 28 volt DC governor-controlled motor. Shutter opening of 72 degrees provides exposure speed of 1/1000 sec. at 200 frames per second.

The camera is available with standard "C" lens mount or GSAP mount and accessories include boresights, tracking finder and various 16mm lenses (including the Fotoperiscope lens assembly for "around-the-corner" shooting). Among the optional features are a timing system, output pulse installation, positive viewfinder with three-objective turret and shutters from 7 degrees to 204 degrees.

The camera is designed to meet the requirements of MIL Spec. 5272A and is currently in use on the Q-24 Ryan Firebee jet drone.

## Thinform 16mm Camera

An unusually compact and rugged 16mm motion picture data camera, called the Thinform Model FDTF-001, has been introduced by Fairchild Data Devices Corp., 580 Midland Ave., Yonkers, N. Y.

Designed specifically for flight test research, it is ideally adapted to installation in thin airfoils or, without pods, on the external surfaces of aircraft and missiles.

The over-all outside dimensions are: thickness-1 1/4", height-8 1/2", depth (front to rear) 7-11/16" without connector. The weight without lens or film is 4.4 lbs. The camera has intermittent-type film transport and operates at speeds of 16, 24, 32 or 64 frames per second. Frame rates are changed by substituting gear sets. The film capacity is 100 feet in the standard darkroom loading magazine, which has been kept to a minimum size by its film displacement design. A 100-foot daylight loading magazine of slightly larger dimensions, and a 200-ft. darkroom loading magazine, are in process of development. All magazines are "ruggedized" against severe impact shock to assure maximum probability of recovering the film undamaged after a test.

The Thinform cameras have been tested to operate properly under the following environmental conditions: acceleration of 25 Gs on the three major axes; vibration of 20 to 55 cps at .060 d.a. and 56 to 500 cps at 10 Gs; 100,000 feet altitude and temperatures from -65F to +150 F.

Thinform equipment, either standard or accessory, includes dual timing lights with separate inputs, a mid-shutter output pulse and a thermostatically controlled magazine heater. Precise sighting and focusing is effected by means of a detachable optical boresight. The camera is driven by a miniaturized high performance motor, either 28 volt D.C. with governor or 115 volt A.C. single phase synchronous.

## The Agfa Automatic 66 Camera

Although automation was first applied to a camera several years ago, only recently has the concept caught on substantially. No doubt many of our readers are familiar with the fact that automatic-exposure control has been applied to several current models of 8mm and 16mm motion picture cameras, such as those produced by Bell and Howell, Wollensak and Revere.

This concept has now invaded the field of still picture cameras with Agfa Inc., 516 West 34th St., New York City, placing on the market an automatic-exposure controlled still picture camera. It is designated the Agfa Automatic 66.

The Automatic 66 is a folding type, roll-film camera, which in external appearance differs very little from other conventional cameras of this class.

Equipped with a 75mm lens and an electric-eye controlled exposure system, the "66" uses No. 120 film, taking 12 2 1/4" square format pictures on each roll.

The automatic-exposure system is an outstanding feature of this camera, giving it its automated characteristics. Briefly, it works as follows:

An electric eye (photocell) mounted in front, near the top of the camera, integrates the brightness of the scene and correlates it with the film's exposure index and lens aperture and then automatically sets the shutter speed to provide the correct exposure for the scene being shot. Speeds of the automatic shutter are, 1/15, 1/30, 1/60, 1/125 and 1/250 second.

Another feature of the camera is that it is equipped with a second manually-set Prontor shutter with speeds of 1/25, 1/50, 1/100 and 1/300.

### A New Kodak Signet 80 Camera

From Eastman Kodak Co. comes an announcement of a new Signet 80 camera with major design advances aimed at combining top miniature camera precision with ease of operation.

Leading features of the Signet are: injection-type film loading, which eliminates film threading problems; a rapid-action film advance lever placed so that a series of pictures can be taken without removing the camera from eye-level; a built-in, easy-to-read, photo-electric exposure meter; a fast 50mm f/2.8 standard lens plus 80mm and 35mm lenses as accessory items and flash synchronization.

List price of the new Signet 80 is \$129.50.

### Electronic Motion Pictures

An interesting method for recording motion pictures by means of electrons is disclosed in U. S. Patent No. 2,839,602 issued June 17, 1958, to Gustave Fries. It is entitled "Method Of and Apparatus For Recording Pictures."

Briefly, Fries' invention covers a method for recording motion pictures through the intermediary of cathode-rays without the necessity of introducing the film into a vacuum or of introducing a raster, thereby limiting the resolution of the recorded images.

No doubt, most of our readers are familiar with the principle of electron photography in the electron microscope wherein sheet film or plates are introduced into the vacuum space of the microscope and the photographs made by direct impingement of the electrons thereon. Since it is impracticable to introduce motion picture film into the vacuum of a cathode-ray tube, Fries has ingeniously solved the problem by recording the electron images outside the tube. He has done this by projecting the electron images through a slot-like Lenard window in the wall of the cathode-ray tube.

Since Lenard windows essentially consist of extremely thin material and are, therefore, self-supporting only over extremely small areas, a very narrow slot is required.

In order to record a full-frame image through the slot-like Lenard window, Fries has provided means for moving the electron-sensitive film past the outer side of the window transversely to the longitudinal direction of the window. Also provided are means for producing a sweep movement of the cathode-ray images in the same direction as and in synchronism with the movement of the film.

A point of interest in Fries' invention is the special electron-sensitive film, which he uses to record the negative image.

This film (which he states as more fully described in the specification of his co-pending application Serial No. 250,472, filed with this patent) comprises a film carrier on which is applied, preferably by vapor deposition, an ionic crystal layer which is sensitive to cathode rays. The negative image on the ionic-crystal film may be transformed into a photographic positive by photographic copying onto a conventional photographic film.

The images on the ionic-crystal film may be erased and the film again used to make a new record.

A feature of this ionic-crystal film is that a positive image may be produced on it by passing the negative image film, if desired, as it is being recorded, through a second apparatus similar to that described above, the images of the negative film being projected through the lens system upon the photo-cathode, so that due to reversal inherent in the method, positive images are produced on the film of the second apparatus.

### Line Voltage Controller for Enlarger or Printer

The Industrial Timer Corp., 1407 McCarter Highway, Newark 4, New Jersey, presents an instrument called the Time-O-Lite Monitor, which is a sensitive and accurate voltage regulator for enlargers and printers.

The Monitor provides a visual and manual control of voltage, which is essential in the new color techniques. It enables the Kelvin temperature of enlarger lamps to be raised by stepping up normal voltage to as high as 135 volts, or will lower Kelvin temperature by decreasing normal voltage to as low as 6 volts. Voltage adjustment is simply ac-

complished by the use of a large knob and an easily read voltmeter. The monitor controls lamps or equipment with a high rating of 500 watts.

The unit can be used in conjunction with a timer, thereby providing accurate timing as well as precise voltage control. The monitor is furnished equipped with replaceable 5 ampere fuse, line cord and load receptacle.

### Victor 16mm Film Viewer

A new 16mm motion picture film viewer, designated as the Victor Viewer, Model VE 16, specifically designed for use by the professional photographer for the inspection and editing of films, has been announced by the Victor Animatograph Corp., Division of Kalart, Plainville, Conn.

The viewer has focusing and framing adjustments, built-in frame maker, and an automatic projection lamp switch which is controlled by the film gate. A large hooded ground glass screen, 3 1/4" x 4 1/4" in size, shows the film in brilliant action. Illumination is furnished by a 75-watt lamp, and the picture on the 3 1/4" x 4 1/4" screen is bright enough to permit comfortable viewing in normally lighted rooms.

The viewer has a film capacity of 99,999 frames—2,500 ft. without resetting. Filmed action can be timed to fractions of seconds. Price of the viewer complete with frame counter is \$92.00. Without frame counter, \$59.50.

### Fotoperiscope: A Lens that Sees Around Corners

Something new in the way of camera attachments—a periscope which permits "around-the-corner" photography with any 16mm motion picture camera, is one of the latest developments of Traid Corp., Encino, Calif. Called the "Fotoperiscope," the attachment was developed to improve photographic coverage of cameras mounted in cramped missile and aircraft installations.

The Fotoperiscope rotates a full 360 degrees and is locked in place by a knurled ring. Built-in crosshairs can be adjusted and locked in a similar manner, thus permitting easy alignment with a particular reference line or object in the field of view. Either "C" mounting threads or the GSAP-type mounting with bolts can be provided on either end, so that the system may be used with nearly all combinations of 16mm cameras and lenses.

### Booknotes, Photographic and Otherwise

*The Detection and Measurement of Infra-Red Radiation*, by R. A. Smith, F. E. Jones and R. P. Chasmer. Oxford University Press, London, 1957. 458 pp.

Occasionally a book is published that, while not strictly photographic, is nevertheless one that should prove of great value to any one, professional or amateur, interested in or associated with infra-red in its broader aspects, including photography.

Such a book is *The Detection and Measurement of Infra-Red Radiation*, which presents an account of modern practice in infra-red techniques, including all aspects such as photo-electric detection, amplifying the signals and displaying the information they carry.

The book contains many selected references of the more important papers covering the subject and is replete with numerous charts and tables. Some idea of the coverage of the volume may be gained from the titles of the 13 chapters, a few of the more significant ones which are listed: I. Infra-Red Radiation, III. Thermal Detectors of Infra-Red Radiation, IV. Photo-Detectors of Infra-Red Radiation, VII. The Ultimate Sensitivity of Infra-Red Detectors, VIII. Sources of Infra-Red Radiation, IX. Infra-Red Optical Materials, X. Optical Components For the Infra-Red, XII. Amplifiers for Use with Infra-Red Detectors and XIII. Atmospheric Transmission of Infra-Red Radiation.

### Photonotes from the Contemporary Periodical Press

#### *Earth Satellite Photogrammetry*

With satellites, unmanned and manned, dominating a large portion of today's scientific effort, it was inevitable that some of our scientists would think of ways and means of using satellites as vehicles for photographic equipment for the purpose of photographing the earth's surface, the moon and even Mars and Venus.

Photoprogess (Continued)

Dr. Paul Rosenberg, President of Paul Rosenberg Associates, Mount Vernon, N. Y., has an interesting article entitled "Earth Satellite Photogrammetry" in the June 1958 issue of *Photogrammetric Engineering*. He explores the subject in a thorough manner and proposes equipment and techniques for accomplishing the task.

Dr. Rosenberg points out that the studies of the upper atmosphere and adjacent space being made by IGY are providing information, which may be used in the design of future satellites, instruments and cameras.

Before earth satellite photography may be successfully accomplished, the problem of the re-entry of the camera-bearing satellite into the earth's atmosphere will have to be solved. With the temperature rise occasioned at initial speeds of 18,000 miles per hour, this presents a difficult engineering and aerodynamic problem of formidable proportions. One advantage of satellite photography is the wide coverage afforded. However, present conventional photogrammetric cameras will only produce photographs of small scale, when taken from satellite altitudes. These would be useful only for planimetric maps and for tying in of large-scale surveys made by other photography.

Since long-focal length lenses will be required—as long as 150 feet, and of extraordinarily large diameter to maintain conventional lens speeds—Dr. Rosenberg proposes the use of reflecting mirrors rather than refracting and the use of folded optics.

He also points out that photogrammetry from a non-recoverable satellite may be possible by recovering the film only. Other methods of obtaining information from such satellites include: automatic development of the film in the satellite with automatic transmission by facsimile to the earth; television camera; PRA terrain scanning system and infrared and radar scanning with the information relayed to the ground.

With the mapping of the earth from satellites completed, new worlds await the photogrammetrist and it will be his task to map the moon, planets and their moons.

In conclusion, Dr. Rosenberg states, "It will be a momentous day in the history of photogrammetry when a photo-interpreter looks for the first time at a stereo image of the craters and mountains on the moon, or the other side of the moon, never before seen by man, or the surface of Venus, or the 'canals' of Mars."

Japanese Optics

Dr. Kogoro Yamada, associated with the Tomioka Optical Co., Ltd., of Japan, writes in the June 1958 issue of *Photographic Science and Engineering* that "until recently, Japan had only a modest optical industry but—now a wide variety of photographic objectives are produced." Dr. Yamada was formerly with the Institute of Optics, University of Rochester, N. Y. He points out that although notable progress has been made by Japanese lens designers since World War II, this information has not been published in English literature. He cites as particularly notable photographic objectives of f/1.1 and f/1.2 maximum aperture that differ in construction from types described by Wynne in a paper published in 1956. Japanese lens designers have recomputed conventional objectives based on the new types of optical glass made in Japan and manufacturers are producing these objectives with greater apertures or wider angles of view.

Dr. Yamada states that there are more than ten prominent lens makers in Japan whose optical designers have made notable progress in lens design.

Included among lenses for 35mm cameras now being produced are two kinds of standard type f/1.1 lenses; three f/1.2; 14 f/1.4 to f/2.0 and more than 6 f/2.8 lenses, as well as 15 wide-angle and 17 telephotos. Dr. Yamada's paper which is entitled "Japanese Photographic Objectives for Use With 35mm Cameras" is well illustrated and presents a comprehensive and up-to-date review of the Japanese optical industry. It is suggested reading for anyone interested in its photographic optical products.

Visual Missile Communications (Continued from page 37)

activate lights, traces on a video screen or other visual indicators.

At this writing, there still must be a man at the console to read and interpret these visual signals.

Visual Indicator Factor

Some progress is being made in passing a continuous picture of the face of a console from one point to another via closed-circuit television. Also automatic tone signals are being used more frequently as a means of activating visual signals.

Recorders are "freezing" the status of operations at any given instant for use in training at some later time, enabling the re-creation of status signals in the sequence which they appeared during actual firing.

Visual signal lights are of various colors but the closed-circuit television which is in the field is of the black and white variety. Will color television be used in future missile systems to relay pictures of the colored status lamps to other components of the system? Or will the push buttons and computer relays which now cause the colored status lamps to flash be used to activate "smarter" computers with larger storage capacity and pre-arranged instructions thus making the missile systems fully automatic? Some of these features are already in existence, so the answer can be yes—if need be.

Will future missile systems be able to "see" incoming enemy missiles, alert and activate the defenses, coordinate and direct surface-to-air missiles to intercept without the visual signals? At least for the foreseeable future the trend away from voice communication and toward visual indicators will continue—first because a visual signal such as a status lamp is generally faster than an audible signal, and second because the visual signal is more accurate. It is difficult to misunderstand a red or a green light.

It is my guess that the surface-to-air missileman in searching for the optimum arrangement of visual, audible and electrical impulse communications will bring the U.S. Army a step nearer to push-button warfare capability. And he certainly will be exploiting visual or any other means of communication which show promise of reducing the gap between the speed of a man and his machines.

Communications Media (Continued from page 40)

in being limited to only line-of-sight systems. Table 4 will summarize the promising modes cited along with range capabilities, traffic capacity and required development areas. Traffic capacity is noted in this table as the probable number of sixty-word-per-minute teletype channels.

CONCLUSIONS

Modes	Range	Traffic	Required
VHF Radio in Air	Trans Oceanic	VHF	Terminal Equipment
VLf Radio in Air	Global	Several T.T. CH.	Matching-Encoding
LF Sound in Sea	Oceanic Coastal	One T.T. CH.	Radiators Encoding
Sound in Rock	Global	Several T.T. CH.	Radiators Data
Ultra-Violet	Line-of-Sight	Above Microwave	Sources Modulator

Table 4

# logistic and industrial supremacy

by Vice Adm. R. B. Pirie, USN

Deputy Chief, Naval Operations (Air), Dept. of the Navy

WITHIN THE LIFETIME OF MOST of us we have seen the Industrial and Military components of our Nation team us as one, and win resounding victories for freedom loving peoples in two World Wars. This Industrial-Military team is still very much intact. Furthermore, as long as the United States and, indeed, the whole of the Free World shall exist, it will be mandatory that this team continue to plan, function and produce—and if necessary—to fight again as one. . . .

It is essential that we as a Nation and a Team grow stronger still in our longest suit—namely, *industrial superiority*. This in turn will continue to provide the military with what we often refer to as our secret weapon.

This so-called secret weapon is not a nuclear or thermo-nuclear bomb, missile, shell, torpedo or satellite, or anything like it. It is much more complex and more essential than any of these. Further, it is really not a secret at all. The weapon to which I refer is *logistic supremacy*.

We will sorely need both *industrial superiority* and its companion *logistic supremacy* if we hope to meet the threat which now confronts us, and which, undoubtedly will confront us for many years to come.

Now, what about this ominous threat to world peace, and to freedom loving people, which seems to loom up on every horizon?

Let's look back a few years. We find, strangely enough, that one of our former allies in World Wars I and II now fanatically embraces an ideology known as Militant Communism. Furthermore our erstwhile friends and allies are convinced that their scheme of life is not compatible with any other. They are therefore dedicated to the unalterable principle that, by whatever means necessary, including the use of force in any degree, all of the people of this earth shall eventually be Communists.

Freedom loving peoples such as ourselves do not take kindly to this proposition. We just naturally recoil. This, because the freedom we and our ancestors have fought so hard to win, and which we cherish so much, seems to be non-existent under Communism.

Nevertheless, by devious means, mostly political, but with force always present and threatened, the Communists have achieved notable victories.

They have enslaved about a third of Europe. They have taken over China with its nearly six hundred million souls. Other equally significant victories are hopefully anticipated by the Communists in the near future. Perhaps in the Near, Middle or Far East. Perhaps in Africa or South America.

They never miss a trick. Wherever the opportunity presents itself, they are on the spot pursuing their objective of world domination with fanatic energy and determination.

Whatever the shortcomings of our Communist adversaries, we must at least give them credit for being brutally frank. They have warned us again and again by word and foreboding action that they mean business; that they intend to impress their ideology and system of slave states upon the entire world—including the 49 states which make up this great Nation of ours.

Mr. Khrushchev, realizing full well that a Communist victory over here will be achieved in no other way, recently summed it all up when he said "We will bury you."

This then is the nature of the threat we face. It is, in fact, a life and death struggle. It is the threat that all men face who regard the price of

*The above was the military keynote address presented at the Fourth Joint Military-Industry Packaging and Handling Symposium in Wash., D. C.*

## THE SECRET WEAPON

freedom as being higher than the price of life itself.

In countering this threat we are confronted with a situation which has no precedence in history. As strategists and logisticians we must try to realize that today and tomorrow we have left the past forever.

In a little over a decade man has irrevocably entered the age of nuclear power, thermo-nuclear weapons systems and supersonic delivery systems.

As for ourselves, and in consideration of the extraordinary capabilities of a tough and ruthless enemy whose objective of world domination never varies—we must be alert and ready for anything.

As a nation we need the industrial power, the military power and the prestige which is sufficient—

*First*—to make it unthinkable for any aggressor to risk all-out global war.

*Second*—to prevent, or if necessary, to win decisively, any limited war or aggression.

*Third*—to support the national policy in cold war. —

With respect to global war we can only fervently hope that the two great world powers have now reached a stalemate. Certainly, and the Communist leaders know this full well, the United States has the retaliatory capability of delivering a massive and decisive nuclear blow to any part of the world. We believe that the Communists have a similar capability.

We know that no war will ever be initiated as the result of United States aggression, because we never have been, and never will be aggressors. We believe we have achieved the necessary retaliatory strength to deter any other nation from contemplating such action against us or our friends.

In short, because of the terrible consequences of an all-out global war, this condition of deterrence means

that as long as we maintain adequate nuclear defense power, the chances of an enemy unleashing a nuclear attack upon us appears to be more and more unlikely in the future.

However, although mankind may indeed take adequate refuge behind this strange shield which we call mutual nuclear deterrence, the basic threat still remains.

Encouraged by the successes previously mentioned, the Communists will simply continue to do what they have done in the past. They will pursue alternate and less risky approaches to world domination.

We see evidence of this on every hand as they flagrantly bring pressure to bear by political, economic, cultural, psychological and subversive programs. Actions such as these constitute aggression, both direct and indirect. They cannot help but lead to the precipitation of *limited* wars and numerous local incidents.

In consideration of the likelihood of limited war, we therefore find it mandatory not only to be prepared to deter a nuclear war, but also to be completely equipped and ready to counter any of the lesser of limited wars which may erupt at any time at any point on the globe.

Korea, Indochina, Suez, Lebanon, and more recently the situation in the Formosa Straits are cases in point.

The cold war which we have been waging with the Communists for many years comprises a constant threat to our ideals, institutions, and our way of life. It is an insidious type of warfare which, for the most part, involves actions short of armed conflict.

All free men and women are front line combatants in the *cold war*. This is because attacks in this type of war are absolutely unrestricted. They are launched in all quarters, around the clock, every day of the year.

Areas in the Cold War encompass the whole range of human affairs. They include education, politics, trade, industry, religion, economics, the arts, world health programs and so forth.

For free men, Communist Cold War victories are just as disastrous and final as if they had been won in a "hot war." The consequences are enslavement.

From the foregoing it is evident that we have no other choice than to be ready for the entire spectrum of possibilities.

To achieve this degree of readiness we need versatile, mobile, balanced and flexible land, air, and naval forces which can provide all degrees of military strength to meet any con-

dition of global nuclear war, limited war, or psychological cold war.

The proper balance of forces we require is now in being. The powerful and widely dispersed U. S. Air Force Strategic Air Command, aided and supported by the Tactical Air Force, has the instant capability of delivering massive retaliatory blows against the enemy in response to any all-out attack which may be made upon us.

Our streamlined, hard hitting Army, which is similarly deployed in strategic locations throughout the world, adds depth to this fearsome deterrent force.

While roaming at will over two-thirds of the Earth's surface—on, under and over the open oceans—a powerful Navy, and the lean and ever-ready fighting Marines contribute in full measure to this persuasive deterrent potential.

Furthermore, the composition and capacity of these balanced forces is such that they not only possess the ability to deter and retaliate, but they are equally competent to meet the threat of limited war, be it large or small. And limited war, as we now well know, is the type of war most likely to occur in this thermo-nuclear age.

Take, for instance, the recent flare-up in the Near East. When the Lebanese Government called for help to safeguard the security of Lebanon, the United States was ready. Time was of the essence. In a matter of hours after President Chaumoun's call to the United States for help, the Marines were landing near Beirut from ships of the Sixth Fleet.

As world leaders in the camp of freedom, we are assisted by all manner of economic and mutual defense treaties which we have with our many friends and allies on every continent.

Because of the geography of the situation we are, in fact, the center of a maritime coalition of more than 40 nations. We are banded together by these treaties, and by the oceans which lie between us.

These ocean areas must be kept open. For without free use of the seas there is no collective security. Without the bridge of ships which constantly ply these oceans each nation would stand alone, unable to receive or furnish help in the struggle against Communism.

We come then to the inevitable conclusion that power at sea—sufficient power to maintain the freedom of the seas—is vital to the very life of freedom itself.

Modern American sea-power is a combination of:

- *One*—mobile air power exemplified by the fast carrier striking force, along with its attendant missile cruisers, destroyers and mobile logistic support forces.

- *Two*—a potent and stealthy complement of missile, and conventional weapon carrying submarines.

- *Three*—extensive anti-submarine warfare forces, including carrier Hunter-Killer task groups, with destroyers, patrol aircraft, and killer submarines.

- *Four*—a mobile sea-going land force, the U. S. Marines, along with the amphibious forces required to position and support them wherever needed.

Foremost among this formidable array of naval weapons, stands our modern day "ship of the line"—the attack aircraft carrier. Here indeed, we have a potent, versatile means of guaranteeing our ability to protect the freedom of the seas. The attack aircraft carrier is an instrument of National power which can react instantly with finite precision to any of the manifold threats of either global, limited, or cold war.

The carrier's realm and operating bases are the seven seas.

She can fight in one place today, and in another place over 700 miles away tomorrow.

The attack carrier causes the enemy to build extraordinary defenses and commit vast forces to counter her deadly unpredictable threat.

Because of her mobility, and the efficiency of her integrated detection and defense systems, the carrier is one of the most invulnerable weapons in our arsenal today.

We have urgent need for a system as competent and flexible as this; for few other weapons in our arsenal can match the modern aircraft carrier's adeptness at:

- *One*—picking the lock in delicate situations, or

- *Two*—battering down the door, should the occasion require.

During the course of my discussion, I have alluded frequently to the important matter of our retaining *industrial superiority* and *logistic supremacy*. In addition, I have used the words—mobility, flexibility, readiness and versatility over and over again in describing the nature of the capabilities we must have to meet the common threat. . . .

Our effort to achieve stability, peace and dignity for all mankind requires teamwork of the highest order. This means teamwork between free nations as well as between all of the elements of our national strength. It means teamwork between military forces.

## AFCEA

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\*Executive Committee Member.

## Association affairs



W. J. Baird  
Editor

### Congratulations!

SIGNAL and AFCEA Headquarters were pleased to learn that their editor, Col. W. J. Baird, USA (Ret.), has received the Legion of Honor, France's highest decoration. The official presentation will take place at the French Embassy in Washington, D.C., during this month.

### AFCEA Honor Awards for 1958-1959

The Gold Medal Honor Awards of the Armed Forces Communications and Electronics Association for the academic year 1958-59 are now available for distribution.

These awards are made annually to outstanding senior ROTC, AFROTC and NROTC students majoring in Electrical, Electronics or Communications Engineering. The recipients of the awards at each school are selected by the military staff and the Dean of Engineering.

To qualify for the award, in addition to being in the fields listed above, the student should have (1) demonstrated outstanding qualities of military leadership, high moral character and definite aptitude for military service; (2) distinguished himself, either academically or by demonstrated leadership through his accomplishments while participating in recognized campus activities, especially if they are in the fields of communications, electronics or photography.

Each award consists of a gold medal and a certificate. In addition, a year's free membership in the AFCEA, which includes a subscription to SIGNAL, is available to each award recipient. The military staff at each school is requested to notify each recipient that this membership and subscription privilege will be valid after September 30, 1959, if the recipient applies in writing for this privilege after that date.

In those areas where there is a

local chapter of the AFCEA, the presentation of the award will be made by an official of the chapter.

### New Group Members

#### Radiation, Inc.

The AFCEA recently welcomed Radiation, Inc. to its group membership. This electronics, avionics and instrumentation manufacturer is located in Melbourne, Florida. Their mailing address is P. O. Box 37.

Members of the firm who will be company representatives in AFCEA are: G. A. Herbert, Assistant to the President; G. S. Shaw, Vice President, Engineering; W. W. Dodgson, Vice President, Contracts; L. R. Everingham, Vice President, Research; A. R. Beach, Technical Advisor; C. H. Hoepfner, Technical Advisor; J. W. Downs, Director, RF Division; L. W. Gardenhire, Director, Astrionics Division; R. E. Dryden, Director, Instrumentation Division, and M. P. Roebuck, Director, R&D Contracts.

#### Smith-Corona Marchant Inc.

The Research and Development Division of Smith-Corona Marchant Inc. has become a new group member in the AFCEA. This communications research and development company is located at 472 Park Avenue, Highland Park, Illinois.

The company representatives in AFCEA will be: E. F. Kleinschmidt, Vice President; A. J. Brown, R&D Services Manager; D. C. Sherrick, Research Supervisor; D. T. Schubert, Patent Lawyer; H. A. Anderson, Senior Engineer; R. A. Michals, Senior Engineer; R. A. Kolpek, Senior Engineer; D. Frick, Senior Engineer; C. Nakata, Senior Engineer, and C. Clark, Senior Engineer.

#### The Singer Manufacturing Company

The Military Products Division of The Singer Manufacturing Company has joined the AFCEA group membership. This electronics and electro-mechanical manufacturer is located at 149 Broadway, New York 6, N. Y.

Representatives for Singer in AFCEA will be: T. W. Benedict, Manager, Military Contracts Div.; R. W. Hewey, Works Manager; D. J. Hocker, Applications Engineer, Military Contracts Div.; W. B. Hunter, Manager, Military Sales Div., Diehl

## Association Affairs

Manufacturing Co.; W. O. Langille, President, Diehl Manufacturing Co.; J. L. McLucas, President, Haller, Raymond & Brown, Inc.; D. J. Peery, Manager, HRB San Diego Laboratories; F. W. Howells, Manager, Military Products Div.; H. N. Karr, Vice President, and N. C. Harris, Manager, Washington, D. C. Operations, Military Products Div.

### Executive Vice President

Captain W. B. Goulett, Executive Vice President, has recently returned from a meeting with the officials of the Detroit Chapter and the IRE Exhibition in Toronto, Ontario, Canada. The purpose of the Canadian trip was to explore the practicability for the future organization of an AFCEA Canadian Chapter and to compare the IRE Exhibition with AFCEA's Annual Convention Show.

## AFCEA Directors Meet

The first of two meetings of the Board of Directors is being held at the RCA Exhibition Hall, Johnny Victor Theatre, 40 East 49th St., New York City, at 2 p.m., 5 November, 1958. Preceding this meeting, the Executive Committee will assemble at the same location at 10:30 a.m. to discuss the 1959 AFCEA Convention as well as other business. The tentative agenda for the Director's Meeting follows:

(1) Introductory remarks by Rear Admiral Frederick Furth, National President of AFCEA.

(2) Approval of minutes of last Board of Directors' meeting, held on June 5, 1958.

(3) Ratification of actions of Executive Committee taken at its meetings of September 4, 1958, and November 5, 1958.

(4) Report of the Executive Vice President for the seven months of Fiscal Year 1958-59.

(5) Report of the Treasurer for the seven months of Fiscal Year 1958-59.

(6) Discussion and vote on the proposed joint convention of the AFCEA and of the PGMIL.

(7) Discussion on new group members.

(8) Discussion and vote on changing the Constitution and By-Laws as may be required to permit the National President to appoint up to ten roving Vice Presidents or Regional Vice Presidents at Large in addition to present allowance of twelve Regional Vice Presidents.

(9) Time and place of next Fiscal Year 1959 meeting of Board of Directors.

(10) Other business.

## Personnel Available

As a service to AFCEA members, SIGNAL will make space available in this column for those members who are interested in employment in the communications, electronics and photography industries. Any member is entitled to three insertions in the magazine on a space available basis, free of charge. Please limit your notice to 5 lines. In replying, employees are asked to address: Box \_\_\_\_\_, SIGNAL 1624 Eye St., N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

**AUDIO-VISUAL INFORMATION SPECIALIST.** Reserve Lt. Col. SigC, former Army Pictorial Motion Picture and TV Producer and Far East Public Information Officer will consider offers in audio-visual field in States or overseas. 15 years motion picture and television experience. Box 139.

**APPLICATION AND LIAISON ENGINEER.** Reserve Signal Officer formerly with Combat Developments Office, U. S. Army Special Warfare School, desires position as application and liaison engineer with company interested in development of special communications and electronics equipment for military application. Box 140.

**TECHNICAL WRITER-EDITOR.** Electrical/electronic equipment. Experience in SigC, Navy and AF data, including SAGE. Also experience in committee establishing E/E Item identification standardization, H 6-1, for OASD. Fluid, lucid, accurate presentation to meet all MIL specs. Box 141.

**NAVY FLAG OFFICER** with over 30 years' naval service and two years' experience as a civilian public relations officer, company executive and member board of directors available for executive or managerial position. Box 142.

**LCDR USN (Ret) (Ex-WO)**—28 years' experience electronics-communications-installation/maintenance—some design/sales experience—desires association with U. S. firm—Resident England but will return U. S. for short indoctrination period if necessary. Box 143.

**COMMUNICATIONS AND ADMINISTRATIVE RADM USN (Ret.)** 31 years' service desires affiliation in communication, administrative or management position. Extensive experience in planning, operation and administration of communication facilities. Master of Engineering Administration, George Washington University. Box 144.

## Government and Military Positions Available

Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.

CAA WILL HOLD EXAMINATIONS for Flight Operations and Air-worthiness Inspector and Airways Flight Inspector. Experience in aviation activities and specified number of flying hours required for some positions. Education may be substituted for part of required experience. Positions located in US, US territories and possessions and some foreign countries. Salaries range from \$5,985 to \$8,330 a year. Applications should be filed with Board of US Civil Service Examiners, Civil Aeronautics Administration, Washington 25, D. C. and must be postmarked not later than Nov. 28, 1958.

### U. S. ARMY ELECTRONIC PROVING GROUND FORT HUACHUCA, ARIZONA VACANCY LIST

1 Supervisory Electronic Engineer (General)	GS-855-14
2 Supervisory Electronic Engineers (General)	GS-855-13
1 Electronic Engineer (General)	GS-855-13
1 Electronic Engineer (General)	GS-855-12
1 Management Analyst (Digital Computer Systems)	GS-303-13
1 Supervisory Military Intelligence Analyst	GS-134-11
1 Electronic Technician	GS-1671-9
1 Illustrator	GS-1020-9
1 Management Analyst	GS-303-9
1 Supervisory Tabulating Equipment Operator	GS-359-9

TRAINING OFFICERS IN THE MILITARY SCIENCES are needed at the U. S. Naval Training Device Center, Port Washington, New York. Entrance salaries are \$7,030 and \$8,330 a year. Persons appointed to these positions will participate in programs for the development, production and utilization of military training devices and in the training of technical personnel to maintain and operate these devices. Applicants must have completed college study in both technical and educational fields, have had appropriate military or civilian training experience, or have had any time-equivalent combination of education and experience. In addition, they must have had specialized experience in training programs concerned with technical equipment. Application forms may be obtained from U. S. Civil Service Commission, Washington 25, D. C., and should be sent to the Board of U. S. Civil Service Examiners, U. S. Naval Training Device Center, Port Washington, New York, until further notice.

## AFCEA Group Members

### Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Aeme-Danneman Co., Inc.  
Admiral Corp.  
Aircraft Radio Corp.  
Allied Control Co., Inc.  
Allied Radio Corp.  
American Cable & Radio Corp.  
American Institute of Electrical Engineers  
American Machine & Foundry Co.  
American Radio Relay League  
American Telephone & Telegraph Co.  
American Telephone & Telegraph Co., Long Lines Dept.  
Ampex Corp.  
Amphenol Electronics Corp.  
Anaconda Wire & Cable Co.  
A. R. F. Products, Inc.  
Arnold Engineering Co.  
Atlas Film Corp.  
Atlas Precision Products Co.  
Automatic Electric Co.  
Automatic Electric Sales Corp.  
Automatic Telephone & Electric Co., Ltd.  
Autonetics, Division of North American Aviation, Inc.  
Barry Controls, Inc.  
Bell & Gossett Co.  
Bell Telephone Company of Pa.  
Bell Telephone Laboratories, Inc.  
Bendix Radio Division, Bendix Aviation Corp.  
Bliley Electric Co.  
Bomac Laboratories, Inc.  
British Thomson-Houston Co., Ltd.  
Bruno-New York Industries Corp.  
Burroughs Corp.  
California Water & Telephone Co.  
Cambridge Thermionic Corp.  
Capitol Radio Engineering Institute, Inc.  
Carolina Telephone & Telegraph Co.  
Central Technical Institute  
Chesapeake & Potomac Tel. Co.  
Cincinnati & Suburban Bell Tel. Co.  
Close Associates, Inc.  
Collins Radio Co.  
Columbia Broadcasting System, Inc.  
Contraves Italiana  
Convair, Division of General Dynamics Corp.  
Cook Electric Co.  
Copperweld Steel Co.  
Cornell-Dubilier Electric Corp.  
A. C. Cossor Ltd.  
Craig Systems, Inc.  
Crosley Division-Avco Mfg. Corp.  
Designers for Industry, Inc.  
DeVry Technical Institute  
Diamond State Telephone Co.  
Dictaphone Corp.  
DuKane Corp.  
Du Mont, Allen B., Laboratories, Inc.  
Eastman Kodak Co.  
Electronic Associates, Inc.  
Electronic Communications, Inc.  
Elgin Metalformers Corp.  
Fairchild Camera & Instrument Corp.  
Farnsworth Electronics Co.

Federal Telecommunication Laboratories  
Federal Telecommunication Laboratories—West Coast Branch  
Federal Telephone & Radio Co.  
General Aniline & Film Corp.  
General Communications Co.  
General Electric Co.  
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Globe Wireless, Ltd.  
Gray Manufacturing Co.  
Hallamore Electronics Co.  
Haller, Raymond and Brown, Inc.  
Hallcrafters Co., The  
Haloid Xerox Inc.  
Hazeltine Electronics Division, Hazeltine Corp.  
Heinemann Electric Co.  
Hoffman Laboratories, Inc.  
Hogan Laboratories, Inc.  
Hughes Aircraft Co.  
Illinois Bell Telephone Co.  
Indiana Bell Telephone Co.  
Indiana Steel & Wire Co.  
Institute of Radio Engineers  
International Business Machines  
International Resistance Co.  
International Telephone & Telegraph Corp.  
Jacobsen Manufacturing Co.  
Jansky & Bailey, Inc.  
Jerrold Electronics Corp.  
Kellogg Switchboard & Supply Co.  
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Machlett Laboratories, Inc.  
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Michigan Bell Telephone Co.  
Montgomery Co., The  
Motorola, Inc.  
Mountain States Telephone & Telegraph Co.  
Mullard Ltd.  
Muter Co.  
National Co., Inc.  
Nelson Technical Enterprises, Inc.  
Nems-Clarke, Inc.  
New England Tel. & Tel. Co.  
New Jersey Bell Telephone Co.  
New York Telephone Co.  
North Electric Co.  
Northwestern Bell Telephone Co.  
Oak Manufacturing Co.  
Ohio Bell Telephone Co.  
O'Keefe & Merritt Co.  
Otis Elevator Co., Electronic Division  
Pacific Mercury Television Mfg. Corp.  
Pacific Telephone & Telegraph Co.  
Packard-Bell Co.  
Page Communications Engineers, Inc.  
Phelps Dodge Copper Products Corp.  
Philco Corp.  
Photographic Society of America

Plessey Co., Ltd.  
Prodelin Inc.  
Radiation, Inc.  
Radio Corporation of America  
Radio Corporation of America, Defense Electronic Products  
RCA Great Britain, Ltd.  
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Ramo-Wooldridge Corp.  
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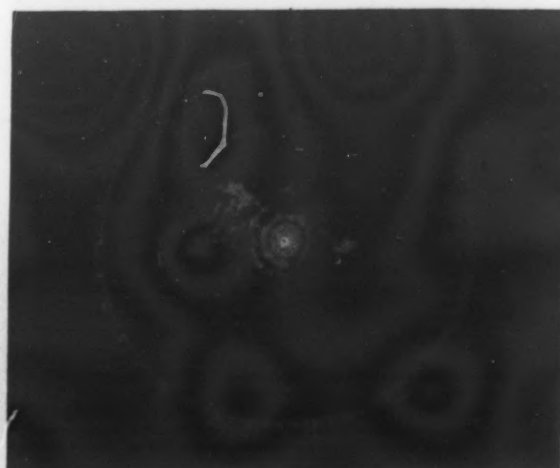
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# Chapter News



**Atlanta**—Chapter President W. B. Bryan introduces the head table guests at the September 9th meeting held at Fort McPherson Officers' Club. At his immediate right are: Col. Julian, president of the Atlanta Historical Society, guest speaker; Ben Gilmer, president of Southern Bell and a national director of AFCEA; John S. Seigle, vice president and general manager of Southern Bell and chapter director; Charles M. Eberhart, Southern Bell, chapter director and a past president. At Mr. Bryan's immediate left: Col. B. E. Small, Signal Officer, Fort Benning, and past president of the Augusta-Fort Gordon Chapter; Lt. Col. Donald L. Adams, Deputy SigO, Hq. Third Army, director and past president; Col. Walton, USAF, Dobbins AFB, and J. S. Bonner, Atlanta Civil Defense Director.

## Atlanta

About 200 members and guests of the chapter met on September 9th at the Fort McPherson Officers' Club. The speaker for the occasion was Col. Allen P. Julian, U.S. Army (Ret.).

Col. Julian, who is now president of the Atlanta Historical Society, gave an extremely interesting lecture and analysis of the Tennessee Campaign and the Battle of Atlanta, delving into the basic strategy and tactics of the two most important campaigns of the Civil War.

The chapter's next meeting is scheduled for November 18th, with Ben S. Gilmer, president of Southern Bell Telephone and Telegraph Company, as guest speaker.

On September 18th, chapter officers and directors met with Wilfred B. Goulett, Executive Vice President, for a general discussion of AFCEA matters. Those present at the luncheon meeting at the Capitol City Club were: W. K. Mosley, Southern Bell, regional vice president; W. B. Bryan, Southern Bell, chapter president; Lt. Col. T. A. Pugh,

Third Army, vice president; Lt. Col. L. J. Ross, Atlanta General Depot, vice president; A. M. Wilson, Southern Bell, secretary-treasurer; W. L. Mollards, Stromberg-Carlson, director; Lt. Col. D. L. Adams, Third Army, director; R. J. Smith, Atlanta General Depot, director, and M. E. Gambrell, Jr., Southern Bell, member.

## Fort Monmouth

There was a record turnout of members and guests for the first dinner-meeting of the fall-winter season held at Gibbs Hall Officers' Club on September 18th. Col. A. L. Burke, new chapter president, presided at the business session.

The featured speaker was Charles A. Kinsley, of the Eastman Kodak Company, a nationally-known lecturer on photographic subjects. He gave an illustrated talk aimed for the individual seeking ideas for more, better and different pictures.

Other chapter officers who took their chairs were: Norman Freeman, Strom-

berg-Carlson Company, first vice president; Col. Robert Haffa, second vice president; Harry C. Ross, secretary, and Thomas R. Schlitz, treasurer.

On the chapter's board of directors are: Arthur L. Adamson, Halsey F. Hubbard, Col. Harold McD. Brown, Col. Fred J. Elser, Raymond L. Gilberte, Brig. Gen. J. E. Heinrich, Edward F. Kolar, J. P. Hoffman, Brig. Gen. A. F. Cassevant, Col. A. T. Stanwix-Hay and Harry Sundermeyer.

## Gulf Coast

W. Kelly Mosley, Regional Vice President, and Wilfred B. Goulett, Executive Vice President, were special guests at the chapter's September 9th dinner-meeting, which took place at the Buena Vista Hotel in Biloxi.

Mr. Mosley reported on regional plans and activities of other chapters in the southeastern area.

Capt. Goulett was the main speaker and gave a comprehensive picture of the Association's background and its aims for the future. He also discussed



**Fort Monmouth**—Three Generals were present for the season's first dinner-meeting which drew more than 200 members and guests. Shown from left to right are: Col. Alvin L. Burke, president of the chapter; Brig. Gen. Joseph E. Heinrich, USAR, a national director of AFCEA; Charles A. Kinsley of Eastman Kodak Company, the guest speaker; Brig. Gen. Albert F. Cassevant, Fort Monmouth Commander, and Maj. Gen. J. O. Mauborgne, USA (Ret.), a former Chief Signal Officer of the Army.

ways and means of improving chapter operation and activities.

### Hawaii

The following are the new officers for 1958-59: president—Capt. Joseph F. Dalton, USN, CO, Naval Communications; first vice president—Robert Lowrey, Hawaiian Telephone Co.; second vice president—Col. Walter E. Lotz, USA, Sig. Off., Hq. USARPAC; third vice president—Capt. Norman E. Zielinski, USAF, Hq. PACAF; secretary—1st Lt. Donald M. Keith, U. S. ACAN Station; treasurer—Mrs. Della Pennington, Finance Branch, Dist. Comms; national council representative—Louis W. Robello, Hawaiian Telephone Co.

Committee chairmen have been appointed as follows: membership—Col. Walter E. Lotz; program and publicity—Capt. Norman E. Zielinski; national security—Robert Lowrey; finance—Henry Zerbe, OPWO, Utilities Div.

### Kansas City

The Army concept of an effective air defense is a combination of men, weapons and determination, Col. Leslie J. Staub, Commanding Officer of the Fourth Region, Army Air Defense, told the chapter on September 18th.

Colonel Staub, speaking before some 100 members and guests at a dinner meeting held at the Richards-Gebaur Air Force Base, said the Army concept would prevent the enemy from making a successful attack from the air. L. E. Eastmond of AT&T, new president of the chapter, presided.

Col. Staub said, "It requires many types of weapons, must not be dependent upon one weapon system, and must have depth, flexibility, and a growth potential that will meet the ever-expanding threat."

"The Army-industry team that assumed responsibility for the original Nike-Ajax went to work in the development of the next stage, Nike-Hercules, as soon as the Ajax stage was operational in 1953."

The Nike-Zeus, an anti-missile missile, third generation of the Nike family, is now in the operational development stage, he said.

The Nike-Hercules, which has an atomic warhead capability, is the type of Army air defense being installed for the defense of Kansas City. Col. Staub said the battery sites at Ft. Leavenworth and Gardner in Kansas and at Lone Jack and Lawson in Missouri are expected to be completed by next summer.

Eleven scale models of the Army's missile family, including ground-to-ground, ground-to-air and the air-to-ground missiles, were on display.

### Louisiana

A dinner-meeting was held on September 10th at the Naval Air Station Commissioned Officers Mess, Alvin Calender Field, Belle Chasse.

Dr. Joseph C. Morris of Tulane University, chapter vice president, present-



**Northeastern University**—Chapter members were well represented among the awards recipients at the University's annual ROTC awards ceremony. Above, Robert B. Richmond of General Radio Company and president of the Boston Chapter, presenting the AFCEA Gold Medal he awarded to Cadet Brig. Gen. Donald L. Johanson as the outstanding senior electrical engineer. Cadet Col. Joseph J. Pikul, center, received the U. S. Veteran Signal Corps Association Medal and Cadet 1st Lt. Paul A. Donato, right, the AFCEA Silver Medal. AFCEA Bronze Medal winner Cadet 2nd Lt. Stephen P. Baranowski is not shown.

ed a demonstration of stereophonic sound using Past President C. C. Walther's RCA equipment.

Special guests for the occasion were AFCEA Executive Vice President W. B. Goulett and Regional Vice President Kelly Mosley, who reported to the membership on national and regional affairs of the Association.

### Montgomery

The chapter's September dinner meeting was held on the 11th at the Maxwell Air Force Base Officers Club. Guest speaker of the evening was AFCEA Executive Vice President W. B. Goulett, who was introduced to the chapter by Lt. Col. Herbert Herman, chapter president.

Captain Goulett congratulated the chapter on its successful reorganization last spring and its vigorous program of activity. He then gave a comprehensive report on the history of the Association and its present plans for furthering its aims and objectives.

Present and representing the Air University were Col. W. H. Lyle, Senior Communications—Electronics Officer of the Air University and Lt. Col. W. C. Royer of the Air Command and Staff College. Representing Southern Bell Telephone Co. from Birmingham were H. B. Lackey, Assistant Vice President; G. A. Hemingway, General Plant Manager, and S. W. Reese, Chief Engineer.

Representing the Montgomery subsection of the American Institute of Electrical Engineers was their chairman, C. S. Weiss, District Engineer of Southern Bell Telephone Co., who is also a member of the AFCEA chapter.

### Northwest Florida

Executive Vice President W. B. Goulett met with Lt. Col. LeRoy Souders, new chapter president, and Ray Atkinson, new chapter secretary, on September 15th. The session was devoted to a thorough discussion of

chapter matters and plans for furthering activity in the Eglin Air Force Base area.

### Philadelphia

Frank D. Langstroth, Marketing Manager—Government, G&I Division, Philco Corporation, has been chosen to head the chapter during 1958-59.

Other new officers were elected as follows: vice presidents—Col. E. L. Littell, SigC, USA; Capt. F. S. Stich, USN; Col. J. K. Warner, USAF; R. G. Wickes, Wickes Engineering and Construction Company, F. O. Ziegler, Radio Corporation of America; Pealer Rossman, The Bell Telephone Company of Pennsylvania; secretary—Conrad Young, G&I Division, Philco Corporation; treasurer—T. H. Armstrong, Radio Condenser Company.

### Philippine

A meeting of the chapter was held on August 18th in the Officers Club at Clark Field, with fifty seven present. The group included members from Navy installations at Subic Bay, Cubi Point and San Miguel, the Chief Signal Officer of the Armed Forces of the Philippines, the Chief Signal Officer of the Philippine Constabulary and many Filipino engineers from Manila.

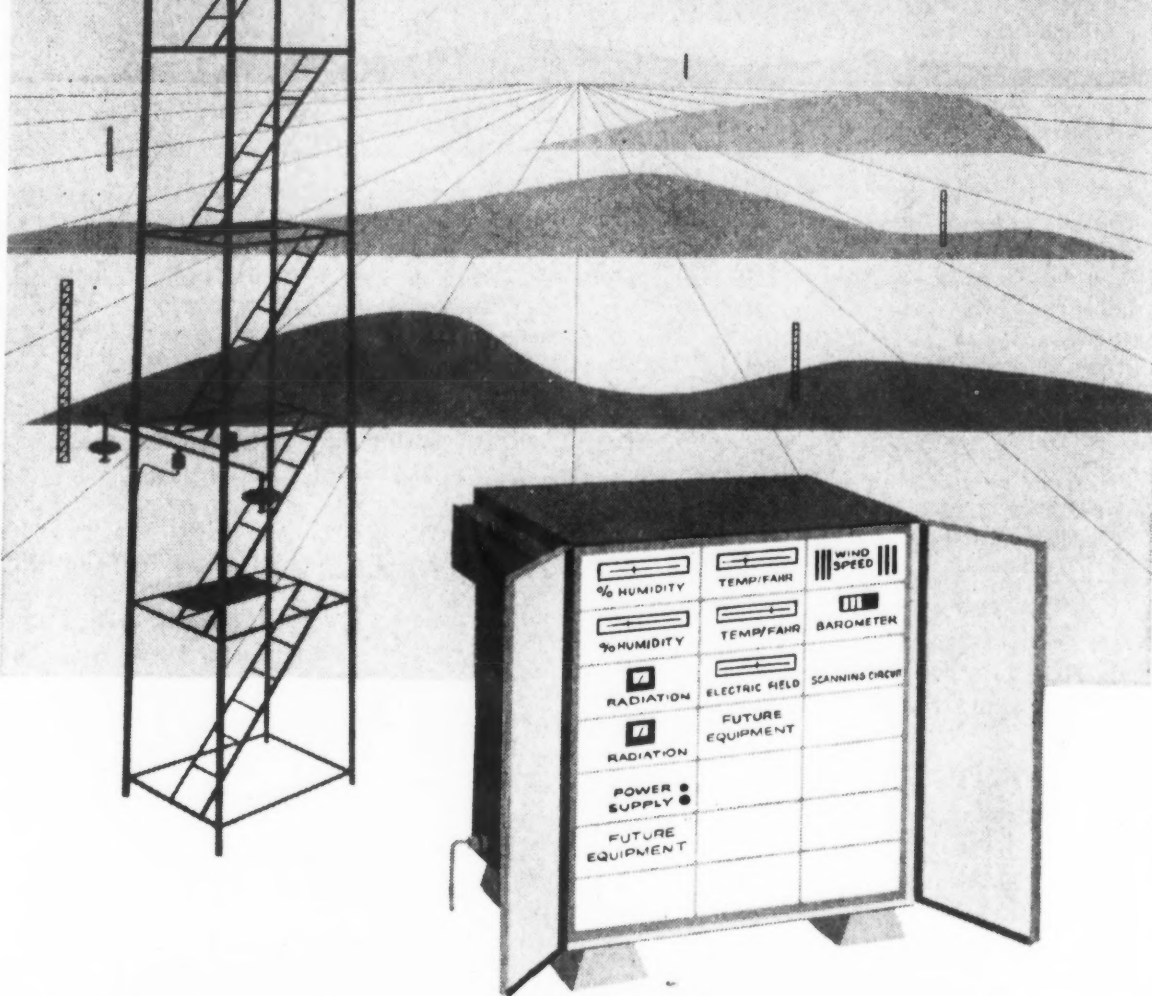
Principal speaker was John Palmer, Chief Engineer of the Manila Broadcasting Company, who gave a technical speech on phase to amplitude modulated transmitters.

New officers elected for the 1958-59 years are as follows: President—Lt. Col. Sidney A. Goldman, 1961st AACCS Sq.; first vice president—Col. Manual B. Syquiao, AFP; second vice president—Pete Vargas, 13th Air Force; third vice president—Lt. Don P. Carlson, US Navy, San Miguel; treasurer—Jay Howe, SAMAP; secretary—Capt. Roy L. Stover, 1961st AACCS Sq.

The chapter is beginning an intensive membership drive to bring together all communications personnel in

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the Philippines in an effort to solve many common communication engineering problems that are prevalent in this part of the world.

### San Diego

The chapter's September meeting took place on the 9th at the large jet air base at Miramar, San Diego.

The evening began with dinner at the General Mess, followed by a tour in two escorted buses through the base to observe latest aircraft support facilities and culminated in a meeting with addresses by personnel on Naval Sea Power, Miramar and Electronics in the Navy.

In addition to rank and file members, the meeting was attended by several members of the Base including Rear Admiral Grover B. Hall, Commander of the 11-12th Naval District, Captain Campbell, Commanding Officer of this Base. Lt. R. H. Crangle, U.S.N., made the program arrangements for the meeting.

### San Francisco

On September 18th, the chapter held a dinner meeting in Millbrae which was followed by a tour of Civil Aeronautics Authority's facilities and control tower operations at San Francisco International Airport.

Two local CAA officials addressed the group at dinner: Ralph W. Glendon, Senior Airways Operations Specialist, dealt with airways operations, particularly air traffic control, and Malcolm C. Nickerson, Deputy Chief, Airways Technical District Office, covered the technical and communications aspects of CAA's job.

The members and guests visited the control tower, where they observed landing and take-off procedures. The tour also included a visit to CAA's Overseas Communications Center.

### Scott-St Louis

At the September 5th dinner meeting, Allan E. Eisenmayer, chapter secretary and educational specialist, 3310th Technical Training Group (ATC), Scott AFB, presented "The Collapse of Time," an illustrated lecture originated by J. Lewis Powell, member of the staff of the Assistant Secretary of Defense for Supply and Logistics. Mr. Powell had delivered this talk as the keynote address at AFCEA's 1958 National Convention.

Secretary Eisenmayer presented the program for the benefit of his chapter with the permission of Mr. Powell with some adaptations for the local audience. The program was received with enthusiasm, which echoed the reception accorded Mr. Powell's presentation at the convention.

### Seattle

The first meeting following the chapter's reorganization was held on September 17th, beginning with dinner at the Officers Club, 13th Naval District Headquarters. Retiring President

## CHAPTER NEWS

Raymond Laine presided over the business session and then installed the new officers and turned the meeting over to Lee David, the new president.

President David stressed the chapter's potential in the Seattle area and opened the meeting to a conference on the problem of increasing membership. A definite program of activity was adopted and the following committees were appointed to carry on the various phases of chapter activity: meeting place—Roy Pace, chairman, Lt. Frieze, assisting; 1961 AFCEA convention promotion—Cmdr. Larkin, chairman; program—Mr. Stiles, chairman, A. A. Baird, Roy Pace, Warren Taylor, and Cmdr. Larkin, assisting; photography—Jim Parrott, official photographer.

### Tinker-Oklahoma City

The chapter's September 18th meeting, held at the Midwest City Golf and Country Club, featured three speakers from the Technical Representative Division of the Philco Radio Corporation, who presented a comprehensive discussion of the development and utilization of the technical assistance and educational service provided by the company.

The principal speaker, John R. Booth, Director of Philco TechRep Division, sketched the history and present utilization of the technical representative services. He stressed that the Philco technical representatives are not trained or assigned to serve only Philco requirements but are a separate service organized to provide a source of technicians and engineers to fill the user's requirements regardless of the equipment used. These men fill the gap between the theoretician or design engineer and the maintenance man and are specifically trained to solve problems of installation, training and maintenance that require an engineering background. Mr. Booth outlined the services offered by the TechRep Division maintenance service, engineering assistance, manufacturing advice, training aids development and educational services. He stated his beliefs that maximum use of new scientific develop-



**Tinker-Oklahoma City**—Pictured during the September 18th dinner-meeting held at the Midwest City Golf and Country Club are, left to right: Col. William L. Gregory, Hqs. Continental AACS Area, chapter president; John R. Booth, Director of Philco TechRep Division, principal speaker and Lt. Col. George L. Timme, Jr., Hqs. Continental AACS Area, chapter director and program chairman.

ments could be achieved only by use of an expanded technical services program.

Mr. Booth lauded the efforts of Oklahoma educators to develop the trained manpower resources necessary for such a program. Standards of education (such as those established by H. T. Archibold, Supervisor of Vocational Education for the State of Oklahoma, and technical training programs similar to that conducted by Dean Hugh Linebeck and Assistant Dean Maurice W. Roney in the Institute of Technology of Oklahoma State University) will be needed to develop the necessary resources, according to Mr. Booth. He introduced to the gathering, Mr. Roney, Dean Fred Robson (Oklahoma City University) and Assistant Dean James H. Jackson (also of Oklahoma City University), who attended as honored guests of the Philco Corporation.

The second speaker, Larry DeLude, also of Philco Corporation, offered the assistance of the Technical Representative Division to any local manufacturers interested in developing military contacts.

In summation, Thomas Walsh, Chief of the Philco Technical Publications Section, discussed the need for competent technical writers to support the expanding need for technical services. He outlined the tasks involved in producing technical publications, then pre-

sented a training film prepared by his section as an example of the need for such aids.

One feature of the evening was the announcement by Bob Davis, chairman of the membership committee, that 22 new members have signed up. Many of these new members were present.

At a meeting of the chapter's board of directors on September 4th at the Tinker AFB Officers Club, plans for the forthcoming year were evolved. The following goals were established: (1) To promote student activities by (a) inviting outstanding technical and engineering students to meetings as guests; (b) distributing copies of SIGNAL magazine to science classes in the city high schools; (2) To build up membership through solicitation of group and individual memberships and encouragement of student memberships; (3) To plan good programs.

Lt. Col. Albert A. Rudd was elected to fill the vacancy on the board of directors created by the transfer of Col. Hal Doolittle. The following committee chairmen were appointed: Program director—Lt. Col. George L. Timme, Jr., Hqs. Continental AACS Area; PIO—Capt. James D. Porter, 3rd AACS Sqdn (Mob), chapter secretary; membership—Lt. Col. Robert E. Davis, Hqs. Continental AACS Area; school activities—Delbert F. Cravens, Southwestern Bell Tel. Co., 1957-58 president of the chapter.



**San Diego**—Some of the members and guests of the chapter are shown at dinner at the Miramar Naval Jet Air Station prior to a conducted tour of the installation. In center of photo, facing the camera, is Rear Adm. Stanley F. Patten, USN (Ret.), a former president of the New York Chapter and now a director of the San Diego Chapter. Opposite him, with back to camera, is Cdr. Samuel Freedman, USNR (Ret.), chapter president. The Naval officer pictured is Lt. R. H. Crangle, USN, information and education officer of the base, who arranged the program.

# ITEMS OF INTEREST

## From Government, Industry and the Services

### Communication to Mars

According to a leading electronics scientist, communication between the earth and Mars is well within reach.

William F. Main, manager of the electronics research division of Lockheed Missile Systems' division in Sunnyvale, Calif., said that while it is "fairly obvious" that the moon now is within radio communication range, it would take "little extension of present techniques" to be able to communicate with a space vehicle in the neighborhood of Mars, which is some 35 million miles away at its closest approach.

"This corresponds to a range increase of some 140 times over that to the moon," he said.

To attain this interplanetary range, Main said, would demand a 20,000 times increase in transmitter power over that required to communicate with the moon which would result in "a clearly unreasonable power level."

But significant extensions of range could be achieved without a proportional increase in power, he said, by utilization of a narrower bandwidth for the communication link.

Main also offered a futuristic approach to interplanetary communication. He suggested that it might be possible to overcome the formidable obstacle presented by earth's heavy atmospheric and ionospheric curtain by positioning a satellite in easy communication reach in a 300-mile orbit to relay messages between the earth and interplanetary spacecraft.

"The ground-to-satellite link must operate within the limitations of the atmosphere," he said, "but the frequency of the link between the space vehicles can be as high as desired, for example, at optical (light) frequencies."

### Space Craft Direction

General Electric has unveiled a working model of an accelerator which can be used to control the direction of space craft in their flights through space. The device is called a "pulsed plasma accelerator."

One of several types being developed by GE, it was built by their Aerosciences Laboratory in Philadelphia. It uses the magnetohydrodynamic principle to propel a low

density gas at high specific impulses.

Inside a T-shaped glass tube, with its normally horizontal cross-arm in a vertical position and the vertical arm extending into an evacuated chamber, a plasma is formed and discharged into the chamber.

The plasma, composed of ionized gas, is produced by a hot electric field generated by regularly occurring sparks between brass electrodes. The current is returned through a brass strap outside the glass tube, setting up a magnetic field to help propel the plasma out the tube into the chamber.

The evacuated chamber, designed to approximate the vacuum conditions of outer space, is produced in a bell jar. Inside the chamber is a paddle-wheel that is propelled by the thrust of the plasma accelerator.

The model accelerator produces a thrust of three-tenths of an ounce, sufficient to change the direction of a space craft in the near-perfect vacuum of outer space. Larger models, with increased power supply and more effective design, are now being developed by GE.

### New Device for Blind

A new, portable aural reading machine will enable the blind to meet more easily the demands of office work, schooling and offer reading by ear rather than through the Braille system (fingertips).

The electronic device, while it cannot as yet convert the printed word into speech, produces patterns of musical tones said to be similar to chords produced by a parlor organ.

According to the developers of the radio-size machine, the blind user can read material in normal print, including typewritten business correspondence.

After 18 or more hours of training, a user should, by interpreting the tones, reach a reading speed of 15 to 30 words a minute. The machine must, however, be moved by hand in close alignment with the lines of type it is converting to sound. This is described as the chief difficulty.

The Battelle Memorial Institute, Columbus, O., under Veterans Administration contract, designed the machine. It is now being evaluated.

The reading discovery weighs approximately 9 pounds and is fitted

into a wooden case measuring 7 by 8 inches. It has knobs for volume, light intensity and the electric power switch. The "workings" consist of three essential parts—a probe to be moved over the printed transistorized oscillators and amplifier and earphones. Two small lights and a lens of the probe project an image upon a row of photocells generating a pitch proportional to height of the black portion of letter "seen." These pitches are transferred to sound patterns by earphones.

### Microwave in Arctic

The Royal Norwegian Air Force, with assistance from the United States Military Assistance Advisory Group and technicians from the Philco Corporation, has recently completed what is believed to be the longest military microwave communication system in the world. The system starts in the southern peninsula and extends northward past the Arctic Circle over "rugged mountainous" ranges and deep fjords.

As reported by Lt. Col. George H. McGee, USAF, this was "a bold venture spurred by urgent military requirements for a reliable 'beltline' of communications over 700 miles of isolated snow-capped mountains, deep fjords, great glaciers and frozen river valleys."

Planning for this system started in December, 1950 and the first construction began in September, 1951. At this time approximately, contracts were let for auxiliary, and in a few instances, primary electrical power supplies. Microwave equipment provided under military aid program started to arrive in mid-1953.

"Not many people," Col. McGee stated, "or wild-cat promoters for that matter, would undertake such a task. Great credit is due the Royal Norwegian Air Force Planners, the Materiel Command and the Tenth Relay Squadron for their hard work that went with overcoming countless difficulties. . . . All possible assistance was provided by the U.S. Military Assistance Advisory Group and Philco Corporation, without which this venture would have been greatly delayed or impossible."

### December Net Speakers

December speakers for the First Army Military Affiliate Radio System (MARS) Technical Net (SIGNAL, Sept., p. 50) will include:

December 3: "International Radio Communication Systems" by E. D. Becken, Assistant Vice President and Chief Operations Engineer, RCA Communications Company.

December 10: "FM Multiplex Stereo System" by Murray G. Crosby, President, Crosby Laboratories.

December 17: "VHF Radio Propagation" by Edward P. Tilton, VHF Editor, American Radio Relay League.

The talks will be held on Wednesday at 9 PM EST on 4030 kc. upper sideband. On December 24 and December 31, the net will not operate.

### Fluorine Harnessed For Space Propulsion

Engineers of Bell Aircraft Corporation have harnessed, for space flight rocket propulsion, a chemical so flammable it will ignite asbestos, leather and even water on contact.

The chemical is elemental liquid fluorine, the most powerful of all known oxidizing agents, which is recognized as "the pinnacle in liquid rocket oxidizers."

Bell Aircraft disclosed recently, with authorization of the U. S. Air Force, that its Rockets Division has accomplished the first large-scale rockets thrust chamber firings utilizing liquid fluorine.

Prior to the Bell program, liquid fluorine, which is so powerful it combines with water to produce a combustion temperature of 5000 degrees, had been used primarily in the atomic energy field.

Significance of the fluorine application to rocket propulsion is that payload increases up to 70 per cent can be achieved with existing ballistic missiles and space vehicles now on the drawing board.

Fluorine can be combined with existing fuels to produce propellant combinations capable of increasing from 22 to 40 per cent the power output of today's rocket engines.

This increased efficiency will allow a tremendous reduction in size and weight of rocket-powered missiles of the future without sacrificing performance.

Research and development work which led to the successful firings was closely coordinated with the Power Plant Laboratory of the Air Force Wright Air Development Center, in Dayton, Ohio, which is sponsoring the work.

### New Laboratory

The new technical laboratory of the National Aviation Facilities Experimental Center was recently dedicated at ceremonies in Atlantic City, New Jersey.

Converted from a former Naval station hospital in a record 60 days by Allen B. Du Mont Laboratories, Inc., under contract to the Airways Modernization Board, the 50,000 sq. ft. structure features a heavy equipment test laboratory, two light equipment test laboratories, a photographic and optical laboratory, model shop, drafting and reproduction areas and conference and general office areas. The laboratory will be used for "testing and evaluating systems, facilities, procedures and devices to meet the needs for safe and efficient air traffic control for all civilian and military aviation."

Maj. Gen. Raymond C. Maude, Military Operations Manager of the Du Mont Laboratories, and an AFCEA director, presented the original drawings to Col. William S. Cowart, Jr., Director of NAFEC.

### Microwave for Police

Although the Virginia State Police makes full use of conventional communications methods (teleprinter circuits and two-way radio-telephone), the heart of its network is a microwave radio and teleprinter circuit serving exclusively the eight most active and important stations in the state. These are: Alexandria, Appomattox, Culpeper, Norfolk, Richmond, Salem, Wytheville and Administrative Headquarters just outside of Richmond.

The "brains" of the system are housed in a small brick building under the 400-foot microwave radio tower at the Richmond headquarters. Especially designed and built by Kleinschmidt Laboratories of Deerfield, Illinois, a subsidiary of Smith-Corona Marchant, the compact, complex automatic switchboard is an electronic "genius." It automatically routes all calls to the proper destinations, gives a "busy" signal if a particular station is sending or receiving a teleprinted message, clears all circuits for a "general alarm" or emergency message and even "remembers" and resumes transmission of messages which were interrupted by the "general alarm."

All this is done automatically—without a human hand touching the switchboard, which is virtually unattended except for brief periods of inspection.

### Digital Simulation

The use of general purpose digital computers in the simulation of new coding and transmission devices shows promise of accelerating and broadening speech and television research, according to Bell Telephone Laboratories.

Scientists, working in acoustics and television, stated that for many laboratory studies it is now possible to avoid the construction of very complicated equipment through the use of such simulation.

Complex experimental apparatus must often be built to test theories or design concepts in speech and video research. This construction is costly and time consuming. In addition, in the experimental stage, it is frequently difficult to distinguish equipment errors from theoretical deficiencies.

Simulation of new devices by large scale digital computers can greatly reduce expense and time lags, and thus makes it easy to investigate a large number of approaches to coding and transmission problems. It even becomes feasible to investigate highly speculative methods which might otherwise have to be ignored. One of the greatest virtues of simulation, however, is versatility, according to the scientists, who emphasized that computers can simulate any explicit operation on a speech or video signal.

Drs. E. E. David, M. V. Mathews and H. S. McDonald, all of the Bell Laboratories, described the use of computers in speech research. Speech is sampled, each sample is quantized into 10 bits or 1024 amplitude levels and delivered to a magnetic tape recorder. These coded samples are recorded in seven parallel tracks, with 200 characters to the inch of tape. These tapes are then fed into the computer, where they are processed according to pre-assigned programs based on the coding or transmission scheme being investigated. The processed signals are then re-recorded, decoded and played back for analysis and listener evaluation.

### Machines That "Talk Back"

According to a Lockheed scientist, production machines that "talk back" to man—and in his own language—are making themselves heard in the expanding age of automation.

Henry M. Lakin, a senior scientist at Lockheed's Van Nuys, California, missile plant, told of his work in the development of man-machine "common languages" at the second International Congress of Cybernetics in Namur, Belgium.

(Cybernetics is the comparative study of the control system—brain and nervous system—of animals and of mechanical-electrical communication systems such as computers. It touches upon most areas of natural and physical sciences.)

Through high-speed electronic computers (acting as interpreters) and a typewriter device (Flexowriter), Lakin explained, automatically controlled production machines will discuss with the operator the progress of the work being performed.

Any number of statements, reflecting almost any situation the machine might encounter, can be built into the computer's brain. Choice of the proper statement would depend on the situation the machine meets. This is signalled to the computer which electronically selects and triggers the phrase.

"And we aren't limited to polite conversation, either," Lakin said. The machine's back-talk could range from strictly-business phrases such as "Have you revised your last instruction?" to "I hope you know what you're doing."

Representing Lockheed at the international conclave, Lakin was invited to address the meeting of top-ranking scientists as the result of his outstanding original work in this field.

#### AEC's Brookhaven

The management of Brookhaven National Laboratory, one of America's primary sources of fundamental research into the peacetime uses of nuclear energy, has installed a Remington Rand Univac Punched-Card Electronic Computer and allied equipment to handle a number of clerical and scientific assignments.

(What is reported to be the world's largest and most powerful atomic machine—a mammoth new proton synchrotron—is being built at this Atomic Energy Commission Laboratory in Long Island, N. Y.)

One of the Remington computers is being used exclusively for scientific work, and the other for accounting and administrative procedures. By taking advantage of the "split-second speed" and accuracy of the Univac, laboratory officials have been able to process statistical information into automatic reports, some of which would have been uneconomical by manual methods.

The various scientific applications include the automatic processing of data taken directly from Brookhaven's nuclear reactor, or atomic pile. A special electronic analogue device, built by Brookhaven engineers, is employed to translate nuclear parti-

cles received directly from the atomic pile into coded instructions which activate a standard Punch. The resulting punched cards, containing the variable factors of certain mathematical problems, are then dispatched from the pile to the tabulating room and run through the computer, which delivers the answers at millisecond speeds and saves human mathematicians a good deal of routine calculations.

On the more conventional accounting applications that involve processing of administrative statistics, the laboratory's inventory control system covers an extensive stock of some 15,000 parts and supply items needed for their work. With their new equipment, the machine accounting department is able to publish an automatic daily up-dating of all quantities on hand and on order, average unit prices and store issue history for the current month, quarter and year, together with comparative figures showing total issues for the previous fiscal year.

#### Names In The News

**Major General Alvin L. Pachynski**, Director of Communications-Electronics for the U.S. Air Force until his retirement from active military duty this summer, has accepted a position with Lenkurt Electric Co., San Carlos, Calif. General Pachynski, as a member of the top management of Lenkurt's Military Division, will become its Director of Program Planning.

**Dr. T. H. James** of Kodak Research Laboratories has been appointed editor of "Photographic Science and Engineering," published by the Society of Photographic Scientists and Engineers. Dr. James, a senior research associate at Kodak, is known for his work on the theory of photographic development and latent image formation. With Dr. George Higgins, he is co-author of the book, "Fundamentals of Photographic Theory."

**Colonel James D. Parker, USAF, Ret.**, was recently awarded the Air Force Commendation Medal in connection with his duty as Director of the New York Air Reserve Logistic Force during the unit's tour of active duty at Olmsted Air Force Base, Pa. Col. Parker is Director, Radio Frequency Engineering, CBS Television Network, N.Y.

**Peter C. Sandretto**, Vice President and Technical Director of ITT Laboratories, Nutley, N.J., discussed the

"Principles of Electronic Navigation Systems" at the Sixth International Meeting of Communications in Rome, Italy, October 10. Sr. Giorgio Gronchi, President of the Italian Republic, chaired the meeting. Mr. Sandretto is a Brigadier General in the U.S. Army and has been associated with the development of radio aids to navigation at the ITT research center since 1946.

**Ellery W. Stone**, President of American Cable & Radio Corporation since 1950, has been elected Chairman of the Board of Directors and will continue as the company's chief executive officer.

**C. Raymond Smith**, who formerly was Vice President of one of Western Electric Company's three manufacturing areas, has been named Director of the company and head of the Radio Division. He succeeds **Frederick R. Lack**, who recently retired.

**Delbert L. Mills** will head the single management of the newly combined division of ITT—Federal Telephone and Radio Company, Clifton, N.J., and Farnsworth Electronics Co., Fort Wayne, Indiana. Mr. Mills is President of the Federal Telephone and Radio. **Vernon L. Haag**, who is Vice President of Farnsworth missile test equipment section, has been named general manager of the consolidated operation in Fort Wayne. **L. C. Haggerty**, President of Farnsworth since 1954, has resigned from ITT to accept the presidency of Warwick Manufacturing Company, in Chicago.

**Major General W. Preston Corderman, USA (Ret.)**, former Deputy Chief Signal Officer for the U. S. Army and recent Commanding General of its Ft. Monmouth signal center, has joined Litton Industries, Inc., as a Vice President.

George Sheets, long prominent in AFCEA affairs, died October 11 in Washington Hospital Center after a long illness. For the past eight years, Mr. Sheets served as Washington representative of Stromberg-Carlson, a division of General Dynamics Corporation and was Secretary of the Washington AFCEA Chapter during 1956-1957. He will be remembered for his interested participation in all phases of AFCEA's activities.

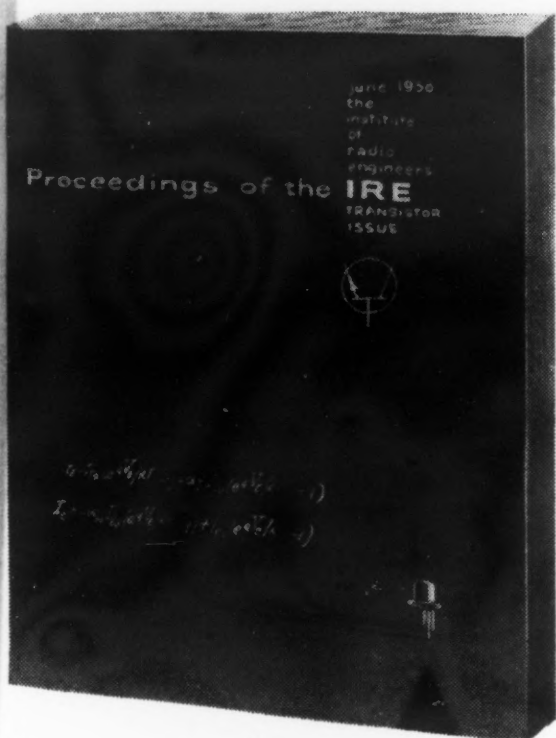
# THE DECADE OF THE TRANSISTOR

IRE commemorates the tenth anniversary of a major breakthrough in solid state electronics by devoting the entire June issue of PROCEEDINGS OF THE IRE to an up-to-date summary of progress and advances in transistors. So small that many can be held in the palm of one hand, these tiny components have ended our 50 year dependence on vacuum tubes. Without transistors, our intricate guidance and communication systems for missiles would be incredibly big and heavy. With them, whole new technologies are being developed, not only for defense but for industry and commerce as well.

## June Issue of Proceedings of the IRE is the New Standard Reference Work on Transistors

Only once before has PROCEEDINGS devoted an entire issue to transistors. That was in November, 1952. Despite a substantial overprinting, every copy was sold within 3 months. This classic issue, coming at a time when there were no books and few papers on the subject, is still considered one of the basic references on the subject...a suitable companion to the definitive Solid-State Electronic issue of December, 1955 and the Ferrites issue of October, 1956.

Now, to mark the tenth anniversary of the transistor, PROCEEDINGS presents the latest advances in theory and application in the June, 1958 issue. Here you will find introductory articles by its inventors—Shockley, Bardeen and Brattain—specially invited papers reviewing progress in all facets of the subject, contributed papers reporting the latest and more important advances in the field. Be sure to order your copy, today!



### Partial Contents:

- "The Technological Impact of Transistors," by J. A. Morton & W. J. Pietenpol, Bell Labs.
- "The Status of Transistor Research in Compound Semiconductors," by D. A. Jenny, RCA.
- "Survey of Other Semiconductor Devices," by S. J. Angello, Westinghouse.
- "Electrons, Holes and Traps," by W. Shockley, Shockley Semiconductor Lab.
- "Recombination in Semiconductors," by G. Bemski, Bell Labs.
- "Noise in Junction Transistors," by A. van der Ziel, University of Minnesota.
- "Formation of Junction Structures by Solid State Diffusion," by F. M. Smits, Bell Labs.
- "Germanium and Silicon Rectifiers," by H. Henkels, Westinghouse.
- "The Potential of Semiconductor Diodes in High-Frequency Communications," by A. Uhler, Bell Labs.
- "Advances in the Understandings of the P-N Junction Triode," by R. L. Pritchard, Texas Instruments.
- "Power Transistors," by M. A. Clark, Pacific Semiconductors.
- "Application of Transistors in Computers," by R. A. Henle & J. L. Walsh, IBM.
- "Application of Transistors in Communication Equipment," by D. D. Holmes, RCA.
- "Characteristics Data on Silicon and Germanium," by E. Conwell, Sylvania.

### The Institute of Radio Engineers

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☐ Enclosed is company purchase order for the June 1958 issue on Transistors.

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# NEW PRODUCTS FROM INDUSTRY

## Ham TV Transmitter

The first commercially-available amateur band TV transmitter in the U.S. has been developed by Electron Corporation, a subsidiary of Ling Electronics, Inc., P. O. Box 5570, Dallas, Texas.

Named the Ling-Mitter, the ham TV transmitter is designed to operate on the FCC-allocated 420-450 MC amateur band at the maximum permissible power of 50 watts. With a proper antenna, TV signals can be transmitted 30 to 40 miles; this is similar to the range of existing high-powered TV broadcast stations to average-height receiving antennas.

The general public will be able to view the ham telecasts, it is said, with the addition of a special UHF converter to their present TV sets. (The signals are video only.) Widespread installation of Ling-Mitters could be of great advantage to the national defense effort for centralized visual observation of urban areas.

The complete TV package station being offered to some 150,000 licensed radio amateurs consists of a Ling Spectator TV camera, the Ling-Mitter, video monitor, antenna and accessories.

In each city where ham TV stations are established, effort to regulate individual transmissions will be needed. If, for example, 30 hams establish stations in one city, voluntary regulations must provide for no more than 10 to transmit at any one time; each ham would be given a 3 MC band width, thus utilizing completely the 30 MC spread between the 420 and 450 MC band.

## Single Channel Stereo System

A new system for transmitting stereophonic sound over a single radio channel has been announced by Electric & Musical Industries, Ltd., of London, and is presently being tested in cooperation with the British Broadcasting Corp. Neither modification to the transmitter nor loss of range is involved, the company claims.

Known as the "Percival System," the new method involves separating the sound program from the directional information at the transmitting end. At the receiving end the directional signal, by operating on the program signal, produces the

stereophonic effect through 2 loudspeakers.

Since only a very narrow band is required for the directional information, practically all the bandwidth remains available for the program itself.

## Bright Daylight Radar Indicator

The development of a new daylight radar set which provides for the first time sharp, TV-like scope images, even in strong sunlight, has eliminated all need of previously necessary light-proof hoods and shields.

Designed and produced by Bendix-Pacific, a division of Bendix-Aviation Corp., of No. Hollywood, Calif., the set was developed in cooperation with Wright Air Development Center and is technically designated IP 451/APS-42A. It will replace present Bendix-Pacific radars now used in USAF troop-cargo aircraft and KC-97 jet tankers. The indicator is also interchangeable with present sets in private aircraft.

Weighing less than 16 lbs. and measuring about 15" in length, the set has a 4-inch viewing area. Adjustment of the cathode ray storage tube by the operator permits his individual preference in brightness.

Company spokesmen compare the new indicator to that of a modern TV receiver, as contrasted to early-day video screens which required darkened viewing rooms.

## Wireless Microphone

Cableless microphone equipment that permits complete freedom of movement to speakers over public address systems has been developed in Germany and has been offered to the American market.

A joint development of Telefunken of Berlin and of Sennheiser Elektronik of Hanover, the equipment consists of a minute microphone that can be fixed to the speaker's lapel and is connected to a transistorized transmitter, about 4x4x3/4 inches and also carried by the speaker.

The transmitter is said to emit 1-microwatt signals on a waveband of about 9 meters and has a range of up to some 65 yards in open air.

Signals are received and amplified by a specially-developed receiver unit and transmitted in the normal way to the loudspeakers.

## Advanced Electronic Memorizer

Engineer Edgard Nazare, presently employed by the French Air Ministry, has perfected an electronic memorizer considered superior in respects to any now in use. The moving parts in it are electrons in contrast to traditional-type equipment which needs perforated cards for its operation, this new machine requires no such outside aids. Eliminating cards, card-perforators, sorting and manipulation, *France Actuelle* reported that questions be posed and answers given by the new apparatus some 200 times more quickly than possible on existing equipment.

The simplified contents and operation of this advanced electronic memorizer offer new utilization scope for this type of equipment. For instance, a worker checking into a factory clock now put his card into an impulse transmitter rather than into a time clock. When time of his arrival and departure have been registered, the new invention, taking into account overtime, bonuses, social security payments and the like, will automatically compute the daily pay owing the individual employee. Thus the firm's payroll is prepared up to the second, any second.

By electronic impulse, information is fed into a memory block, 1/4 cubic meter large, where it is registered. A corresponding electronic impulse sent into the machine elicits the response. Each memory block, weighing 660 pounds, can retain 24-million signals, a capacity far greater than that of perforated-card machines. Only one person is required to operate the machine efficiently.

## All-Transistor Airborne Computer

Philco Corporation recently announced readiness for production of what is described as the world's fastest and first all-transistor airborne computer, the C-1100 series.

Outstanding features of the computer are designated as reliability, flexibility, high-speed operation and transistorized circuitry. It operates 10 times faster than any commercially available airborne computer; for instance, it can perform 64,000 additions or take 16,000 sq. roots per second.

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This miniature Transac computer handles all computational requirements necessary to control a jet aircraft from take-off to landing.

A few of the C-1100 control applications are auto-pilot, air data (speed and altitude), cruise control (proper altitude for high fuel efficiency), automatic navigation and engine performance. Also, it constantly analyzes its own operation. In a military jet, moreover, it computes weapon delivery and interception.

In addition to aircraft control, the airborne computer can be used for other mobile or industrial control applications.

## Low Cost Nylon Bearings

The numerous engineering benefits derived from the use of nylon bearings are available to manufacturers now at a significantly reduced cost in the standard line of snap-in Nyloners being produced by Thomson Industries, Inc., of Manhasset, N.Y. This applies also to special bearings made to customer specifications. In production quantities, the new reduced prices are claimed to be lower than comparable metal bearings.

Also representing savings in installation cost, Nyloners are split to provide a compensation gap for the relatively large expansion and contraction of nylon, and thus can be slightly compressed by hand to be quickly snapped into place. No press fitting is required and installation as well as removal is a simple operation. In addition, Nyloners can be used without lubrication.

## High-Performance Power Transistor

Called a "major advance in the germanium power transistor field," the development of a new high-power, high-frequency transistor has been announced by the Bendix Aviation Corporation. The new transistor is claimed to out-perform all other germanium power types now in use.

The unit, called the Bendix DAP (Diffused Alloy Power), is the result of 2 years' research effort which succeeded in combining the diffusion technique with the alloy technique of manufacturing.

The DAP is claimed to have amazing electrical characteristics in the areas of high frequency and power, along with excellent circuit stability. Power gain is 5 to 10 times greater than in a standard alloy type. Also, the unit is capable of increasing switching speed and frequency response 3 to 5 times faster than the standard alloy type. The new tran-

sistor fabrication process can be developed to handle 5,000 watts in a switching application. Present samples can switch approximately twice as much power as comparable alloy types.

Application of the new transistor will bring improved frequency response and distortion to the hi-fi field and much quicker response than present-type transistors to the computer field. Its excellent characteristics promise major benefit to the fields of guided missiles, ultrasonics, oil-field exploration, TV and tools for the handyman, as well as in ultrasonic cleaners for many industrial and commercial applications.

## Transistor Circuit Synthesizer

To enable designers to check the performance of contemplated circuit designs without the need for a "breadboard" of soldered wires, a new electronic unit called the Transistor Circuit Synthesizer has been developed. Four independent panels—each a transistor stage—and a master metering panel comprise the instrument.

Developers of the unit, National Electronics Labs., Inc., 1713 Kalorama Rd., NW, Washington, D. C., claim that the Synthesizer provides extreme flexibility for assembling common base, common emitter and common collector circuit configurations. By combining two or more transistor panels through wires or plug-in shorting bars, circuits such as amplifiers, flip-flops, oscillators and gates can be readily assembled.

Either PNP or NPN transistors can be used. A floating battery power supply is contained within the cabinet, and the negative, positive or in-between taps can be selected as ground reference. This permits use of the instrument in combining stages of PNP with stages of NPN transistors, with only one multi-tapped battery supply.

The metering panel features a curve tracer which allows for a visual display of the plot of collector voltage versus collector current.

## 4-Channel Mobile Radiotelephone

Automatic Electric Co. of Northlake, Illinois, has developed a new manual radio dash unit for mobile radiotelephone service which permits the radio user to select any one of four radio channels available in an area.

Initially, the vehicle is signaled

over a primary channel. When an alternate channel call has been made and completed, the unit restores the equipment automatically to that primary channel. Either 6- or 12-volt electrical systems operate the dash unit.

## Electronic Longhand Writing Machine

A new electronic longhand writing machine called the Electrowriter, which is capable of operating over wire or radio circuits, had its first public showing by the Comptometer Corp. of Chicago, Illinois, at the recent National Business Show in New York City. The company characterized the Electrowriter as an important development in instantaneous longhand record communications.

Said to be capable of operating over any single standard telephone circuit, the instrument is used like an ordinary pen and pad of paper and instantaneously produces local and remote records of the message. The self-contained units range in size from that of a desk calendar to that of a small adding machine with no auxiliary boxes. All Electrowriters are compatible and any desired number can be connected with each other.

The machine, which is completely transistorized with no separate wiring installations needed, will be leased to users. It is designed for easy maintenance and the company will service the machine through its 108 servicing organizations in the United States and Canada. A. E. Carlson, formerly president of the Gary Group's Associated Telephone & Telegraph Company and executive vice president of its Telephone Bond & Share Company, is president of the Comptometer Corp.

## Communication Transceiver

Collins Radio Co. of Cedar Rapids, Iowa, has announced a new HF single sideband communication transceiver, the 32RD-1, which features high stability, simplified controls for non-technical operators, voice actuation of transmitter function, automatic load control, compact station packaging and superior communication and spectrum conservation through the use of the company's SSB.

The unit is being marketed in two configurations—the cabinet version (32RS-1C) and a rack mounted version (32R-1H).

The transceiver has an output of 100 watts PEP on any one of 4 pre-tuned channels in the 1.6 to 12 mc frequency range.

Accessories available for the unit include directional wattmeter, phone

patch, antenna coupler and a number of antenna kits.

### **Portable Traffic Signal**

Featuring all the elements of a regulation signal, the new portable radio-controlled traffic signal called "porta-signal" is small enough to be stored in the trunk of an automobile, is light enough to be carried and can be set up for use in several minutes.

A product of the Dryomatic Corp. of Alexandria, Va., the unit provides a simple setting of switches allowing an operator the choices of push-button control, red-amber flashing or automatic standard sequence. A tiny radio transmitter also permits remote control of the signal at distances up to  $\frac{1}{4}$  mile.

Weighing 61 lbs. including heavy-duty battery, the waterproof traffic light telescopes up to  $8\frac{1}{2}$  ft. from its aluminum case.

### **"Sound Husher" For Telephone Users**

When the telephone is in use, the Carloma "Sound Husher" automatically lowers the volume on any TV, radio or hi-fi to which the device is connected. Picture reception on TV is not affected, and the volume returns to normal when the receiver is replaced.

Thirty feet of wire, a phone clip and the wire connectors come with the "sound husher" and the ensemble may be purchased for \$2.25 from Tennessee Valley Development, Inc., Dept. AF 8, P.O. Box 17, Oak Ridge, Tenn. Extra wire is also available at 3 cents a foot.

## **New Literature**

### **"Engineering Notebook"**

"Engineering Notebook," a new film produced by Western Electric Co., Inc., and featured at a program conducted by that organization in New York last September, vividly projects this central theme: While an engineer's solution to a single problem may not appear to be by itself overwhelming or highly significant, it is the successful merger of many ideas from many engineers that forms the basis of the company's technological progress. In the film, an engineer's notebook is used as a symbol of engineering ideas.

Actual solutions to many of the individual engineering and manufacturing problems that occur are often posed in many different manners and by different engineers. The process of arriving at the best concept for

each particular need in the unit under development, before the final goals of high reliability and economical practical manufacturing techniques are in sight, provides interesting viewing against the backdrop of Western Electric's engineering division and plant facilities.

The manufacturing and supply unit of the Bell Telephone System, Western Electric is also engaged in the manufacture of large electronic systems for the military agencies of the U.S. Government.

The film ends with the conclusion that there is one thing beyond the reach of machines no matter how impressive they become: the creation of ideas. There is really no last page in the engineering notebook.

### **1958 Directory of Independent Labs**

Listing some 500 different services in testing and inspection and in applied research which are being performed by leading independent laboratories, the 1958 edition of the *Directory of the American Council of Independent Laboratories* was made available last month.

Copies, free of charge, must be requested on company letterheads from Dr. Harold M. Dudley, Executive Secretary, 4302 East-West Highway, Washington 14, D. C.

### **Scientific Activities Report**

A summary report released by the National Science Foundation, *Scientific Activities in Six State Governments*, represents a project conducted to analyze expenditures of 6 states for R&D as well as other related scientific activities during fiscal year 1954. Selected as representative of major U.S. geographical regions, and of varying resources, physical size and economic characteristics, were California, Connecticut, New Mexico, New York, North Carolina and Wisconsin.

An example of the report's findings is the fact that of a total of \$69 million for all scientific activities in the 6 states, over \$57 million was reported as expended for research and development. This figure represents approximately 2% of the total expenditures for all purposes by the 6 states. Over \$15 million of the total \$69 million was contributed by the Federal Government.

Copies of the report may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C., for 40c per copy.

### **Soviet Nuclear Research**

Over 100 titles representing latest Soviet research in atomic energy to be presented at the 2nd International Conference on the Peaceful Uses of Atomic Energy have been published, in list form, by the Chronicle of United Nations Activities.

Among the Soviet studies to be presented are details of the Soviet Union's fusion experiments, including a description of a toroidal chamber.

Additional Soviet papers detail the role of nuclear power in Russia, describe a chemical plant which produces fuel for the first Soviet nuclear power reactor and discuss a study of the recently launched atomic breaker.

In the field of isotopes, the papers describe the use of iodine-131 for diagnosis or therapy of thyroid disorders, uses of isotopes in investigating metallurgical processes, and applications of radio-isotopes in clinical medicine.

Other Russian papers deal with explorations into the basic structure of matter, these including research on fast reactor physics and studies of the nature of plasma.

The lists are available, free of charge, from the Document Service, Dept. R, The Chronicle of United Nations Activities, 234 W. 26th St., N. Y. 10001.

### **Gyro Primer**

There is now available an excellent "primer" for the many whose curiosity has been anxiously awaiting a lucid exposition of the novel gyro operating principles and techniques that have been developed by Norden-Ketay Div. of United Aircraft Corp. of Commack, Long Island, New York.

The 65-page presentation embodies a highly adequate and most interestingly presented group of illustrations. Among the appendices is a checklist of information needed to specify gyros, a selected reading list and magazine reprints concerning recent developments of the Norden-Ketay Div. For example, *Aviation Age* covered the uniquely successful unheated floated rate gyro developed some few months ago for missile application. This Model 55000 boasts of being compact, rugged, reliable, of having long life and high output pickoff of needing no heaters, of being in production and of having industrial acceptance already established.

Also provided are condensed specifications for gyromechanism Model 55000 floated rate gyro, for type FG 205 free gyro, type DG2-4 directional gyro and type GS205 compensated vertical gyro.

## Search List

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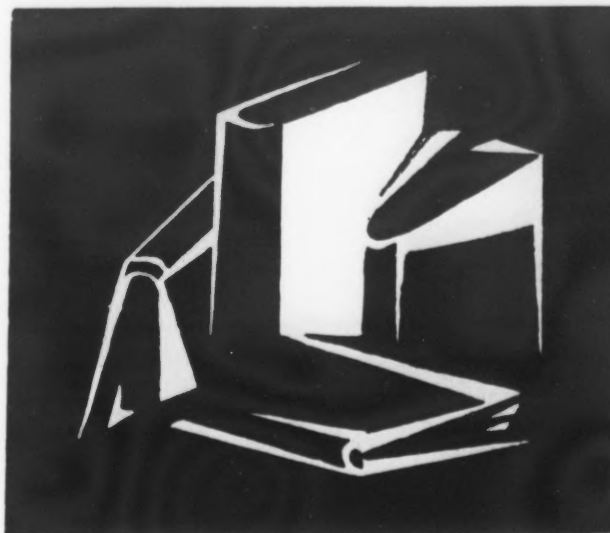
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## Books

**THE PENTAGON CASE**, by Col. Victor J. Fox. Freedom Press, New York. 247 pages, \$3.25.

"Col. Victor J. Fox" is the pen-name of the author who has set inside the boundaries of fiction *The Pentagon Case*, a story which proceeds to scrutinize the Pentagon structure so as to lay bare what he believes to be a willful indifference to letting itself be drawn into serving the cause of Communistic propaganda.

Giving voice to those objections formulated within the author's experience, the drama revolves about the frustrated efforts of a loyal staff officer endeavoring to expose an enemy underground cell operating within the Pentagon.

*The Pentagon Case* is considered to have a great potential for becoming one of this year's most important pieces of "fiction."

**THE EXPLORATION OF SPACE BY RADIO**, by R. Hanbury Brown and A. C. B. Lovell. John Wiley & Sons, Inc., New York. 207 pages, \$6.50.

A presentation of the results and possibilities in the investigation of the universe by radio methods constitutes the main theme of this work coauthored by Doctors Brown and Lovell.

Within its eleven chapters, the book provides an astronomical background and covers such subject areas as: some properties of radio waves; techniques of radio astronomy; galactic and extragalactic radio emissions; the hydrogen line; the scintillation of the radio stars, solar radio waves, meteors, radio and the aurora borealis; the Jodrell Bank radio telescope, and radio investigations of the moon, planets and the earth satellite.

**CHAMBERS'S TECHNICAL DICTIONARY**, Ed. by C. F. Tweney and L. E. C. Hughes, A.C.G.I., D.I.C., B.Sc., Ph.D., M.I.E.E., F.R.S.A. The Macmillan Co., New York. 1028 pages, \$7.50.

Compiled by a large contributing body of authoritative specialists actively engaged in the practice and teaching of their respective subjects, this reference work is a newly revised third edition which has been significantly enlarged to contain 55,000 entries. These definitions cover more than 100 branches of scientific and industrial activity.

Important new terms concerned with the latest advances in science and technology are found in a 74-page supplement that holds nearly 5,000 definitions.

Additions to the revised work include aeronautical terms dealing with supersonic flight, guided missiles, and the most recent aero-engines; new chemical substances comprising drugs, antibiotics, dye-stuffs, plastics, weedkillers, insecticides, etc., with structural formulae; and definitions of electronic terms used in connection with computers, automation and color TV.

The more recent terms of astronomy and nuclear physics are also included while those new words resulting from recent discoveries in the field of chemical elements are found in the tables appearing at the end of the volume.

A highly recommended reference tool, this updated work deserves wide inspection.

**INTRODUCTION TO PHOTOGRAPHIC PRINCIPLES**, by Lewis Larmore. Prentice-Hall, Inc., New York. 229 pages, \$8.00.

Camera enthusiasts, as well as the scientist whose position entails some use of photography, will welcome the rich source of information found in this easily understandable account of the scientific foundation upon which photography rests. In brief, the volume states the basic principles of physics, optics and chemistry which make possible the reproduction of a scene on film; then, the application of these principles to achieve photographs of excellent quality is fully demonstrated.

After explaining the various types of cameras and their capabilities, the author reviews elementary optical problems. A lengthy discussion of the properties of film reveals why a good negative depends upon camera optics and film sensitivity. After an explanation of elements of photographic chemistry and printing, the subsequent chapters consider more advanced phases of optical theory, covering essentials of stereoscopic (3-D) photography, color photography and colorimetry.

More than 100 illustrations clarify key principles and the appendix presents 15 experiments possible with modest facilities and equipment.

Lewis Larmore, Ph.D., whose background holds more than 20 years' experience in photography, both as teacher and scientist, is senior scientific advisor to Lockheed Aircraft Corporation.

**THE COMPLETE BOOK OF SUBMARINES**, by Cmdr. C. W. Rush, USN, W. C. Chambliss and H. J. Gimpel. The World Publishing Co., New York. 8" x 11", 160 pages, \$4.95.

At her launching on January 17, 1955, the *U.S.S. Nautilus* gave birth to the beginning of a new era of sea navigation. Being essentially the first "true" submarine, the *Nautilus* claims that vast region beneath the ocean's surface as her proper habitat. When she does surface occasionally, it is not to replenish her own expended powers but to yield to the only limiting factor in her subsurface endurance—the physical limitations of man to withstand the environment. Such an achievement as this can only spur one's desire to investigate submarine history.

Spanning events from the time of the first successful undersea venture by Alexander the Great to the present age of the atom-powered *Nautilus* and its daring future possibilities as a servant of peace as well as of war, Cmdr. Rush and his two associates have authored a vivid reading adventure of discovery and invention. The wealth of photographs and diagrams added to the absorbing nature of presentation serves to provide that piquant flavor that distinguishes dry encyclopedic inquiry from captivating armchair enjoyment. The wise use of this excellent illustrative material has eliminated scores of written paragraphs of arid explanation.

Of further interest are the chapters given to description of a submarine's construction, its propulsion plant and its operating techniques.

And the element of human interest has not been neglected. Discovering how submariners learn and practice their skills promotes a keen awareness of the specialties involved, and the included evolution of various methods devised for escape from a disabled submerged submarine provides some fascinating and informative pages.

# AFCEA Insignia

Available for immediate purchase: Lapel button for civilian dress, bronze — \$1.50, sterling — \$2.50 and gold — \$5.00. AFCEA official medal, bronze — \$3.00, silver — \$4.00 and gold — \$5.00. 3" dia. decalcomania, 4 for \$1.00. Membership certificate, \$1.50.

All insignia may be ordered from: AFCEA Service Dept., 1624 Eye Street, N.W., Washington 6, D. C.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the act of Congress of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, of SIGNAL Magazine, published monthly at Washington, D. C. (additional entry, Baltimore) for October 1958.

District of Columbia } ss.  
City of Washington }  
Before me, a notary public, in and for the State and County aforesaid, personally appeared W. J. Baird, who, having been duly sworn according to law, deposes and says that he is the Editor of the SIGNAL Magazine and that the following is, to the best of his knowledge and belief, a true statement of the ownership and management of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946, to wit:

1. That the names and addresses of the publisher, editor, managing editor are:  
Publisher: Armed Forces Communications and Electronics Association, 1624 Eye St., N. W., Washington 6, D. C.  
Editor: W. J. Baird, same address.  
Managing Editor: Judith H. Shreve, same address.

2. That the owner is: (if owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)  
Armed Forces Communications and Electronics Association, 1624 Eye Street, N. W., Washington 6, D. C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:  
None.

4. That paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also that the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

W. J. BAIRD,  
Editor.

Sworn to and subscribed before me this 14th day of October, 1958.

(Seal) HAZEL JANE DAVIES,  
Notary Public.

(My commission expires June 30, 1960.)

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## Why SIGNAL?

Here are several good reasons why an AFCEA-SIGNAL membership is of importance to you. It affords chapter affiliation with friends in the electronics field. It creates a very congenial climate for the members of a civilian-military team to discuss and solve problems of mutual interest.

Secondly, SIGNAL Magazine is a continuing contact with the profession of communications, electronics and photography. It provides its readers with the best information on timely subjects and major developments of professional interest. It gives our advertisers a crystal clear shot to present facts about services, products and achievements to a specialized and interested audience.

Thirdly, the AFCEA Convention guarantees a highly intellectual and wide audience to hear presentations of technical papers on the latest in technical achievements and trends of the future. Members, guests and friends are given an opportunity to view first hand an entire display of products and/or services in an atmosphere of a masterfully coordinated technical show.

Lastly, of particular interest will be the continuation of SIGNAL's special Stockpile Concept of Feature Articles, which will contain a reservoir of editorial content on subjects relating to our national security. Always the alert, SIGNAL's Editorial Staff will present a new 1959 feature concept. Details will appear in subsequent issues.

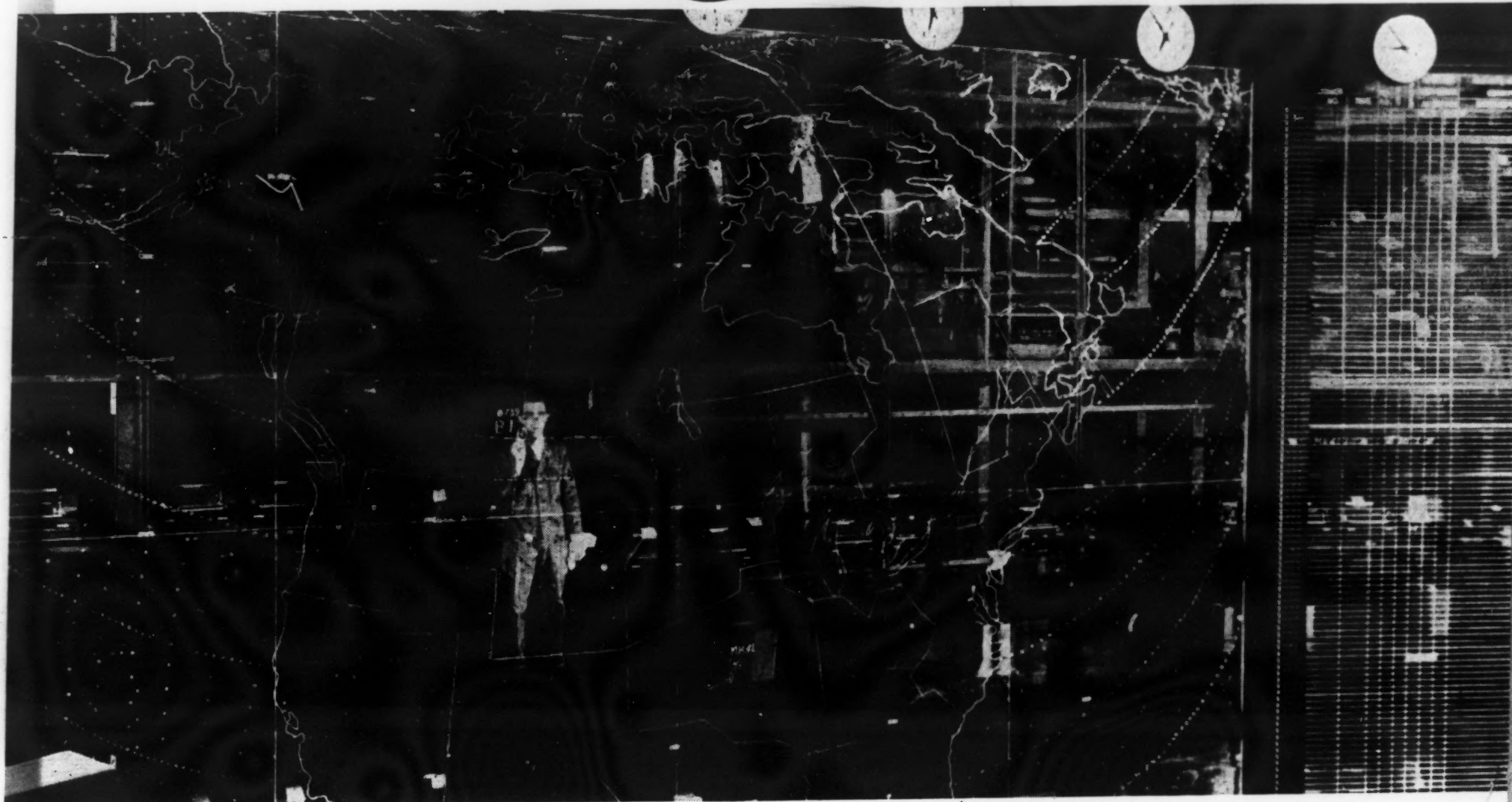
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reserver of Peace...

**Wrap-around  
bumper for  
a continent**

# NORAD



Headquarters—NORAD—Colorado Springs

Like a huge "bumper" wrapped around the North American continent and reaching down along both the Atlantic and Pacific shores, the North American Air Defense Command (NORAD) has been created for operational control of air defense units of the Army, Navy and Air Force of the U.S. and the RCAF Air Defense Command of Canada. Its field includes the vast area between the southern border of the United States and the

northernmost limits of Canada and Alaska. Under the functional control of NORAD will be BMEWS (Ballistic Missile Early Warning System) and SAGE (Semi-Automatic Ground Control Environment) for the defense of specified sectors. In addition to its responsibility as prime contractor for BMEWS, the Radio Corporation of America is working on other important electronic assignments for NORAD.



**RADIO CORPORATION of AMERICA**

DEFENSE ELECTRONIC PRODUCTS

CAMDEN, N. J.

## The Great Dragon Raid of 1405

Legend has it that one balmy spring afternoon in 1405, during the Ming Dynasty, a flight of dragons, cruising at low altitude, swooped down and demolished all the radar stations posted along the Great Wall of China.

Thus, the first DEW line (Dragon Early Warning) in history was pulverized at a stroke. But Emperor Ming, who had spared no expense in building his dragon-net, had the last laugh.

True, not a single antenna remained standing.

Every last one was eaten to the last savory shoot by the bamboo-loving dragons.

However, not a single dragon survived his meal. Every last savory bamboo shoot had been poisoned by the Emperor, who obviously didn't put all his trust in electronics . . . as who would in 1405 B.B. (Before Bomac)?\*

Moral: There are more ways than one to bamboozle dragons.



\*

# Bomac

Leaders in the design, development and manufacture of TR, ATR, Pre-TR tubes; shutters; reference cavities; hydrogen thyatrons; silicon diodes; magnetrons; klystrons; duplexers; pressurizing windows; noise source tubes; high frequency triode oscillators; surge protectors.

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